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THE ADMINISTRATION

OF

INDUSTRIAL ENTERPRISES

WITH SPECIAL REFERENCE TO FACTORY PRACTICE

BY

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PREFACE

The purpose of this work is to present what may be called first-class practice in the administration of industrial enterprises. The manufacturing industry is the one which has been held in mind chiefly.

The major topics, in order of their presentation, are, first the problem of equipment, second, the formation of an administrative organization, third, the adjustment of the relations of labor and capital and, fourth, the process of mercantile distribution.

In discussing physical equipment it has been necessary to skirt the borders of a vast field of technical knowledge, choosing such matter as the general executive should possess in his attempt to supervise the work of technical experts.

With reference to administrative organization, the aim has been to bring the contributions of scientific management into relation with the general body of underlying principles of administration which are valid for all forms of joint action; and to do so by sketching the evolution of administrative practice rather than by a systematic review of pure principles.

The relations of labor and capital have been handled with two leading purposes in mind, namely, to present the labor problem from the viewpoint of the employing manager and, second, to elaborate somewhat the meaning of the new philanthropy which aims to bring to the less favored classes a fuller measure of the rational objects of life, through the organized and normal processes of industry, rather than through extra-economic alleviative agencies.

The methods of mercantile distribution are presented in outline, without entering upon a criticism of the vast wastes

entailed by the modern evolution, for the reason that it is becoming customary to separate the discussion of industrial organization from that of commercial organization, and for the further reason that the Author hopes at a later time, *Deo favente,* to present a work upon the American domestic market.

Throughout this book two things have been held in mind; to trace the application of the scientific method in industry, and to point out the efficiency and the charm of an economic policy based upon welfare and service.

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THE ADMINISTRATION OF INDUSTRIAL ENTERPRISES

CHAPTER I

THE NEW METHOD AND THE NEW SPIRIT

The New Method

The American evolution. — American industry is now in a transitional state. At first, for us as a nation, economic growth meant the mere spread of the settled area westward, with increase of population, and enlarged totals of production, and the multiplication of business units on the same plane of method and purpose. The economic process presently became more specifically the exploitation of crude resources. Inventive genius revolutionized the mechanism of farming and lumbering, and made possible a speed and scale of operations which soon transformed the western farmsteads into something like the southern plantations, — but with machines as slaves, — and developed the saw mills from local custom shops into factories producing standard articles for distant markets. The early successes with mechanism created such a conscious pride in the nation's inventive genius that succeeding steps in industrial progress developed the railroad amazingly on its mechanical side, and forced from infant to adult state all that class of manufacturing which depends chiefly upon machinery.

The law of the machine presently suggested large-scale production, so that, as the domestic market was of enormous extent, the effort to enlarge profits soon became one to extend

selling campaigns over the entire country, through the evolution of previously unknown arts of publicity. Success in this achievement opened the way for the consolidations of the decade 1895–1905, and later, in which the arts of financing achieved a forced growth. As a result of the trust movement, there were constructed some powerful consolidated interests, and patched together a number of loose agglomerations of heterogeneous establishments, which all began to look forward hungrily toward ultimate monopoly. Thwarted in this aim by the assertion of public will, enterprise was next shunted in the direction of perfecting legal monopolies, under the shelter of the laws of patents and trade marks, the process being to differentiate and specialize merchandise, and identify it for purposes of exclusive control by the use of packages, coined names, and exclusive "talking points." These methods also have now encountered the resistance of Federal law and Supreme Court interpretation. Thus, in various directions, competitive effort has been exploring the field of possibilities. In each direction, after a certain evolution has taken place, natural limitations have developed themselves, so that it has been necessary to find a direction of less resistance elsewhere.

The factor of administration. — Now that the careless use of resources must give place to conservation; and that the problem of mechanism is not simply to invent machines, but to adapt them to the laws of fatigue; now that the economies of production on a large scale are measurably exhausted; and that industrial units have grown to great size, only to discover that they require an art of administration comparable to the strategy of war or the government of states, it is becoming clear that, henceforth, the problem of industry is no longer one of simple extension, but is the more difficult one of refining the texture. The administrative technique must be revised throughout. Leaders and lieutenants are required who are thinkers, rather than drivemasters. Men of investigative and scientific temper are needed who can formulate policies upon an enduring foun-

dation of accurate knowledge. Representatives are wanted who can justly conceive their relations to the general interests of society, and avoid punishment at the hands of a public opinion which has grown vigilant. Alongside of the traditional economic categories, "Land, labor, and capital," there must be installed a fourth primary wealth-producing factor, — management.

Present wasteful practice. — "Very few of those who have not made special investigations," says Harrington Emerson, "realize how very low the average efficiency of endeavor is, even in a highly civilized country like the United States. Everywhere we see brilliant results; rarely can any one follow the losses between result and initial supply.

"Not only are recurring wastes more flagrant than is generally admitted, but it is also not realized that very hard and extremely exhausting work is not an evidence of efficiency. It is not because men do not work hard, but because they are poorly directed and work under adverse conditions, that their efficiency is low. . . .

"Railroad repair shops throughout the country do not show 50 per cent efficiency on an average as regards either materials or labor.

"In a big locomotive shop, a careful study of the machines which had been in operation for twenty years showed that the location of 75 per cent of them would have to be changed, so as to facilitate the orderly, effective, and economical progress of work from one to the other. This and other eliminations of wastes doubled the output, with less labor costs.

"Coal wastes on railroads are almost as bad as labor and material wastes. On a very large railroad system, the fuel charged per 1,000 tons of train weight per mile averaged 260 pounds; yet actual tests where all coal used was weighed showed a consumption between terminals of only 90 pounds. This actual consumption could be doubled, be made 180 pounds, yet this standard be only 60 per cent of the coal paid for. . . .

"Mr. Taylor found a labor efficiency of only 28 per cent in the rough labor employed in the Bethlehem Steel Company's yards. The writer, by time studies, determined an efficiency of only 18 per cent in a gang of laborers excavating a foundation, and even less on some construction work in the erection of the large office buildings in New York.

"Inefficiency is not a local evil. It extends through the whole of American life — extends through the whole industrial life of the world."[1]

Mr. Gilbreth, the leading expert in motion study, has estimated that the loss due to the inadequate division of labor between men of greater and less skill in the manual trades is sufficient, if it could be saved, to pension one half the workers in the United States on full pay.[2]

Science and industry. — It is significant that, at this time, the attention of men everywhere is turning to the scientific study of industry. Industry is the greatest exponent of action in modern life: science is the chief exponent of modern thought: much is to be hoped from the union of the two. The contrast between the efficiency of science and the inefficiency of tradition has been so strikingly illustrated in medicine and surgery, and in warfare, that the inference can no longer be repressed that science can likewise help industry onto a higher plane of efficiency. In a couple of decades the general attitude of business men toward science has changed from neglect or distrust to profound respect.

Already there has been convincing contact between science and industry. Science has devised many new processes and compounded new materials and constructed useful instruments of precision. Some one of the many branches of engineering now reaches almost every industry. Already the geologist directs the miner, while the lumberman begins to respect the forester, and the farmer asks for the appointment of a district

[1] Efficiency as a Basis for Operation and Wages, N. Y., 1909, pp. 15–24.
[2] F. B. Gilbreth, Motion Study, N. Y., 1911, pp. 73–74.

adviser who has been educated at an agricultural college. As men of scientific training, the engineers are having a wide range of administrative duties thrust upon them; while in the demand for trained accountants and actuaries and employment officers and secretaries of commercial associations, may be seen a hunger for scientific control which has become keen in all departments of practical action. The general advance of practice is betrayed by the multiplied use of laboratories and planning rooms, in the rapid rise of a literature devoted to the search for principles applicable to industry, in the growth of university courses in business administration, and in the multiplication of scientific societies for various classes of industrial experts. We have already witnessed the formulation of a body of intelligent administrative principles for the control of the raw-material industries, as the result of the "conservation movement." And now American industry is concerned with a newly announced code of rules known as "scientific management," which aims to give greater precision and efficiency to the productive processes involved in manufacturing. Upon the heels of these events we can perceive in another quarter an increasing restlessness expressed in the "high cost of living movement," which promises to bring the distributive industries, also, upon a new plane of scientific operation.

The scientific method. — The scientific method differs from ordinary thinking in degree rather than in kind. It may be briefly described as the orderly, persistent, and thorough use of the mind: a sort of sublimated common sense. It may be more fully described by dividing it into steps, as follows:

1. The analysis of the facts, problems, or conditions, which are made the subject-matter of study, into their elements, to improve the ratio between the difficulty of the subject and the natural vigor of the investigating mind, and to insure the collection of data in a form sufficiently disintegrated to be manageable. Professor W. D. Scott, in one of his books says, "It is a general law of psychology that all things tend to fuse, and

only those things are analyzed that must be analyzed. . . . We do not at first perceive the parts and unite them to form the greater wholes, but we first perceive the wholes, and only after the process of analysis has been completed do we perceive the parts."[1]

2. A very complete, and even exhaustive collection of data, sufficient to make it certain that the law of the subject is fully recorded, and to reduce accidental errors and other variations due to chance to a negligible, or at least to a definitely calculable, percentage.

3. The classification and arrangement of facts in such a telling manner as to show all significant agreements, differences, and concomitant variations between them, so that everything may be brought to bear clearly and definitely in answer to a given question; and so, also, that the juxtaposition of ideas will finally lead the mind to take the fourth step.

4. The making of inferences, or the drawing of conclusions, from the facts by induction, deduction, analogy, or any other logical method; using ingenuity to choose the most effective order and combination of these methods, and imagination to increase to the utmost the vigor and span of the mind.

In inductive reasoning the order of procedure is from the specific to the general, beginning with individual facts and building up to principles. Deductive reasoning passes from the general to the specific, showing that principles necessitate certain specific facts, or that restricted principles are contained within those of a more general nature. There is no conflict between the proper functions of inductive and deductive reasoning; the only matter for dispute is their relative fitness in any particular case, considering the nature of the subject-matter, and the character of the individual minds involved. Most persons use induction and deduction in the most intimate alternation.

Analogy rests upon the perception of a like arrangement

[1] Theory of Advertising, Boston, 1903, pp. 98–99.

between the parts of two distinct bodies of truth, and the inference that what is true in one set of circumstances is likely to be true, in some degree, of similar circumstances. The value of the analogy lies in the fact that by it certain cases, in which the relations are clear and conspicuous, can be used to familiarize the mind with the nature of a relation so that, when similar phenomena are studied, we are able to detect the presence of the relationship, even though it be subtle and partly hidden in its new form.

The inference or new idea which is the product of investigation is not to be at once permitted to exercise full and unrestricted influence upon the judgment, but only such influence as will facilitate the taking of the fifth step.

5. New inferences are to be subject to criticism and test in every possible way, by the use of established facts, to determine whether these inferences are truth or error. Ultimate reliance is placed upon the harmony of all parts of truth with each other, and upon the equal validity of truth for all normally constituted minds.

Those who think over their experiences, and deduce general conclusions from them, soon raise themselves out of the confusion of specific instances, pass beyond the limitations of rules of thumb, and liberate themselves from the laborious safeguards of mere retentive memory. As the late Professor William James, said: "The best possible sort of system into which to weave an object, mentally, is a *rational* system, or what is called a 'science.' Place the thing in its pigeon-hole in a classificatory series; explain it logically by its causes, and deduce from it its necessary effects; find out of what natural law it is an instance — and you then know it in the best of all possible ways. A 'science' is thus the greatest of labor-saving contrivances. It relieves the memory of an immense number of details, replacing, as it does, merely contiguous associations by the logical ones of identity, similarity, or analogy. If you know a 'law,' you may discharge your memory of masses of

particular instances, for the law will reproduce them for you whenever you require them."[1]

Motion study as an illustration of the scientific method. — Let us select two illustrations to show the scientific method of solving problems of production, and to give some indication of the efficiency which may be attained by its aid.

Mr. Frank B. Gilbreth, a mechanical engineer and contractor, who in his youth had learned the bricklayer's trade, some years ago came under the influence of Mr. F. W. Taylor, the chief exponent of "Scientific Management." He determined to study the process of laying brick, to see whether or not improvement could be made in it. At first sight the undertaking seemed presumptuous. Bricklaying is one of the oldest of the crafts, having a history dating from Babylon and Nineveh. For several hundred years no noteworthy improvement in processes had been made. Mr. Gilbreth, however, made persistent observations of the most detailed character, disentangling the processes into the elementary movements composing them, and observing the position and character of the apparatus and supplies and finished work which determined the efficiency of each movement.

The traditional method of laying brick is familiar to every one. Mr. Gilbreth found tenders bringing up thick mortar and unselected brick to the scaffolding, and dumping them at the feet of the masons. The scaffolding was raised only at intervals, when further reaching was impossible, and was then put up even with the wall. He found the masons reaching and stepping and stooping to get mortar and brick, often pausing to work up the mortar or select the best face of a brick. On the wall the mortar was spread and cut off, the ends of the brick were buttered, and the brick was tapped into position with the handle of the trowel. The mortar squeezed out by the tapping was then cut off and disposed on the wall or the board. In this way there was completed a cycle of operations containing eighteen elements.

[1] Talks to Teachers on Psychology, N. Y., 1899, p. 126.

Mr. Gilbreth soon began to introduce changes. One of the first things done was to devise a new scaffolding. This was planned to include, first, a lower platform consisting of a front portion next the wall, on which the mason stands, and a rear part, away from the wall, along which the tender walks. A second platform consists of a shelf upon which the mortar and brick are disposed conveniently to the hand of the mason. The front of the material shelf is seventeen inches from the line of the wall, thus eliminating all stooping and stepping for supplies on the part of the mason. The scaffolding was so constructed that it could be raised by the tender, a few inches at a time.

The order in which the brick should be placed in the wall was next studied. A sequence was worked out for each type of wall, involving the least total travel in laying up a given number of courses. To save the time used by the mason in picking out sound brick and selecting the best face, low-priced helpers were employed to do this work on the ground; the brick being sent to the mason, and sometimes to the job, in packets of twenty four selected brick, each brick having the best face up. To avoid loss of time with the mortar, a box was devised with sloping sides so that the mason might insert the trowel without looking, while his eyes followed the other hand to the brick packet. Strict control of the consistency of the mortar was instituted so that a brick could be pushed into its place on the wall without tapping, and without cutting off extra mortar.

By means of such improvements this ancient craft has been completely changed. Of the eighteen processes previously performed by the mason, ten have been eliminated, one has been arranged to appear only in every other cycle, three have been combined with other elements, and two have been improved. The apparatus has all been redesigned — even a fountain trowel being invented; the materials have been standardized in quality and located at the most convenient points; the most economical movements and sequences of movements have

been adopted; and a rational division of labor has been worked out between mason and helper. As a result of these changes, a mason can now lay 350 brick per hour with no more fatigue than the laying of 120 brick per hour would have entailed under the old system.

The speeding of machines as an illustration of the scientific method. — Another example of the utility of the scientific method may be found in the investigations made by Messrs. Taylor, Sinclair, Gantt, Barth, and others, into the elements which compose the problem of setting the proper speed for a machine tool in cutting a metal. The history of this investigation is given by Mr. Taylor as follows: "In 1881, in the machine shop of the Midvale Steel Company, the writer began a systematic study, by devoting the entire time of a large vertical boring mill to this work, with special arrangements for varying the drive so as to obtain any desired speed. The needed uniformity of the metal was obtained by using large locomotive tires of known chemical composition, physical properties, and hardness, weighing from 1,500 to 2,000 pounds. For the greater part of the succeeding twenty-two years these experiments were carried on, first at Midvale, and later in several other shops, under the general direction of the writer, by his friends and assistants, six machines having been at various times especially fitted up for this purpose. The exact determination of these laws and their reduction to formulae have proved a slow but most interesting problem."

We may pause to remark that the accurate fixing of the variables involved, and so the final setting of the most profitable speed in metal cutting, is a problem which could by no possibility have been solved by the mechanic unfamiliar with higher mathematics, through the use of ordinary experience; nor could it have been transmitted from one workman to another as a rule of thumb or craft tradition. The variables entering into the case have been enumerated by Mr. Barth as, 1, The size and shape of the tools to be used, 2, The use or not of a cool-

ing agent on the tool, 3, The number of tools to be used at the same time, 4, The length of time the tools are required to stand up to the work (life of the tool), 5, The hardness of the material to be turned, 6, The diameter of the material or work, 7, The depth of the cut to be taken, 8, The feed to be used, 9, The cutting speed, 10, The cutting pressure on the tool, 11, The speed combination to be used to give at the same time the proper cutting speed and the pressure required to take the cut, and, 12, The stiffness of the work.

To return to Mr. Taylor's recital of the history of the experiment, he says: "By far the most difficult undertaking has been the development of the methods and finally the appliances (*i.e.* slide rules) for making practical use of these laws after they were discovered. The difficulty, from a mathematical standpoint, of obtaining a rapid and accurate solution of this problem will be appreciated when it is remembered that twelve independent variables enter into each problem, and that a change in any of these will affect the answer.

"In 1884 the writer succeeded in making a slow solution of this problem with the help of his friend, Mr. Geo. M. Sinclair, by indicating the values of these variables through curves, and laying down one set of curves over another. Later my friend, Mr. H. L. Gantt, after devoting about 1½ years exclusively to this work, obtained a much more rapid and simple solution. It was not, however, until 1900, in the works of the Bethlehem Steel Company, that Mr. Carl G. Barth, with the assistance of Mr. Gantt, and a small amount of help from the writer, succeeded in developing a slide rule by means of which the entire problem can be accurately and quickly solved by any mechanic." [1]

It is necessary to design a slide rule for each type of machine on the basis of the number of tools to be used, the cooling device, the attainable speeds, and the power of the machine

[1] F. W. Taylor, Shop Management, pp. 179–180.

to resist stresses. When, further, there has been a proper standardization of the size and shape and material of the tools, and of the depth of cuts for given classes of work; and after allowance has been made for the hardness of the material, and the stiffness of the work, it is possible to sift the problem down to a few combinations of speed, feed, and life of tool. Choosing the most efficient combinations, special slide rules can be prepared to indicate quickly what pulley and cone combinations must be used to drive the tool at the indicated speed on work of a given diameter.

Difficulties of application.—It is to be expected that the project of introducing a new method of handling the practical problems of industry will encounter difficulties. The champions do not at once acquire perfection in practice; and as they feel their way toward a new point of view their utterances are not even entirely consistent. The great mass of minds are mildly negative, preferring that some one else should "waste money" on experiments. Active hostility arises from those who think their organization or their cause is in danger.

It is easy to misunderstand the nature of a movement like that to employ scientific methods. In the past, science applied to industry has meant the handing over of some new material, or instrument of precision, by scientific men to capitalists for development. Or it has meant the installation here and there in industry of a man of scientific training, to control some particularly intricate process. The present movement signifies that all the problems of industry — administrative, commercial, and financial, as well as those of a physico-technical character — are to be looked upon as problems of science, to be investigated with the care and thoroughness heretofore characteristic of pure scientific research only.

It may be objected that old methods in industry have proved their fitness by surviving; and that there is a hazard of a new method not proving applicable. The scientific method is not, however, something different in kind from ordinary methods

of thinking, but is rather thinking raised to a high standard of strictness and completeness. It has no quarrel with the sudden illumination of intuition or the slow wisdom of unsystematized experience. The scientific method has never had to retreat from any field in which it has been established; and it has already produced brilliant results in industry.

In carrying the methods of research over into industry it must be recognized that financial and time limitations will exert an important effect upon the procedure followed in investigation. An endowed research, or a research carried on as an avocation subsidiary to teaching in institutions of higher learning, may be excused from strict accounting as to the relation between results and expenditure in a measure that industrial research cannot be. Nevertheless, concessions should not be allowed to sap the significant characteristic out of the new movement, for the purport of it consists precisely in that, whereas temporary and superficial methods have long been in vogue, it is now proposed to see what thorough-going investigations will accomplish.

Closely coupled with this point is the further one that, in industrial investigation, the working hypothesis must play an important part. While results in pure science may be long withheld from application until ideally complete and ideally confirmed, in industrial research ultimate goals will be reached rather through a series of approximations, at each step of which intermediate results will be used to secure a differential advantage in competition, by which the next step in advance is financed.

In industrial research, where the factors involved are always numerous, great care will always be required to determine the comparability of data; and a large allowance will always be necessary for disturbing conditions. In many branches of scientific research it is possible to bring conditions under such control as to largely eliminate disturbing influences. A laboratory may, indeed, be viewed as an instrumentality for reducing

the number of variable factors which require to be dealt with at one time. But in industrial research the laboratory is the wealth-producing and distributing system upon which society depends for the satisfaction of its current needs. This equipment can only to a very slight degree be turned from its original purpose to serve as a laboratory. When the United States Steel Corporation desired to compare the records of various plants of a similar character, it had first to install a uniform system of cost accounting. A basic cost was then determined for each plant. By fixing a series of permissible differences in costs, to allow for inequalities in the conditions of different plants, it became at length possible to compare individual records fairly with a standard of attainable cost, made by averaging the results of the six best establishments. Thus an internal competition of records was inaugurated which proved to be more searching in its discovery of the true causes of efficiency and inefficiency than the previous competition of prices upon the open market had been.

Industrial research requires the reduction of final recommendations to simple form, to insure rapid and general utilization. Of this the history of the application of the slide rule to machine speeding affords an excellent example. Complications may be little noticed among experts, but when experts undertake to prescribe standard practice for industry, the methods must be such as can be understood and controlled by the average business administrator.

The New Spirit

When a group of new methods show themselves in any department of practical action, it usually implies that some fundamental point of view has been changed and that a basic transformation is taking place which will mean new decisions upon many specific matters. When we say that a man has become animated by a new spirit or a new point of view, we mean that he has grasped an idea which has far-reaching con-

nections, and which enters as a component factor into the formation of a wide range of practical judgments. That such a master-idea underlies "Scientific Management" was affirmed by Mr. F. W. Taylor in the following remarkable passage. "Scientific management," said he, "is not any efficiency device, not a device of any kind for securing efficiency; nor is it any group of efficiency devices. It is not a new system of figuring costs. It is not a piece-work system; it is not a bonus system; it is not a premium system; it is no scheme for paying men; it is not holding a stop watch on a man and writing things down about him; it is not time study; it is not motion study nor an analysis of the movements of men; it is not the printing and ruling and unloading of a ton or two of blanks on a set of men and saying, 'Here's your system; go use it.' It is not divided foremanship or functional foremanship; it is not any of the devices which the average man calls to mind when scientific management is spoken of. I am not sneering at cost-keeping systems, at time study, at functional foremanship, nor at any new and improved scheme of paying men, nor at any efficiency devices, if they are really devices that make for efficiency. I believe in them; but what I am emphasizing is that these devices in whole or in part are not scientific management; they are useful adjuncts to scientific management, so are they also useful adjuncts of other systems of management.

"In its essence, scientific management involves a complete mental revolution on the part of the workingmen engaged in any particular establishment or industry — a complete mental revolution on the part of these men as to their duties toward their work, toward their fellow men, and toward their employers. And it involves the equally complete mental revolution on the part of those on the management's side — the foreman, the superintendent, the owner of the business, the board of directors — a complete mental revolution on their part as to their duties toward their fellow workers in the management, toward their workmen, and toward all of their daily problems. And without

this complete mental revolution on both sides scientific management does not exist."[1]

The scientific spirit. — There are certain qualities of will, and attitudes of mind, and virtues of disposition which are favorable to the use of the scientific method. Aware of the many imperfections of the human mind — cramped as it is by habit, dulled by ignorance, and swept by emotion — the general attitude of the searcher after truth should be watchfulness with regard to himself and tolerance for the mistakes of others. The perception of truth demands complete eradication of such preconceptions and prejudices as may prevent due allowance for any pertinent fact; it calls for breadth of interest to welcome suggestions from any source; and it requires concentrated attention to make progress by fully comprehending each thing in its turn. The ideal is a fluent, sensitive, teachable spirit.

The scientific attitude is one of candor, compounded of confidence and humility, in facing the truth, and in conforming to reason, whatever that may necessitate. Miss Edith Wyatt, who was retained by a prominent publisher to investigate the condition of women in certain establishments operated according to efficiency principles, testified before a Congressional Committee, "I have never seen so great a spirit of candor in any establishment in regard to hours, or wages, or any particular as in these establishments where this system has been tried."[2]

The progress of an investigation aiming at the truth demands watchfulness not to be bound by class views, or old habits of mental approach. Thoroughness is attained by energy and tenacity in working oneself deeply into a subject. Clearness comes from pondering the facts again and again in one's own mind, and from filtering one's opinions through the minds of others. Consistency results from carefully unravelling and

[1] Hearings before the H. of R. Sp. Com. on The Taylor and Other Systems of Shop Management, Washington, D. C., 1912, III, p. 1387.

[2] *Ibid.*, 1912, I, p. 600.

explicitly stating everything which is involved as implicit or assumed in the conclusions one holds.

When once a position has been taken as the result of an investigation, the scientific temper exerts itself to avoid dogmatism and undue fixity of opinion. It strives to hold judgment more or less open on all complex matters, so that new truth will be hospitably received, while yet making necessary concessions to the requirements of immediate action through temporary policies or working hypotheses.

Under failure much can be retrieved by a courage which is sufficient to look a situation squarely in the face, and so collect the necessary knowledge for a more successful policy.

The search for truth should not be allowed to degenerate into dull mole-work, but should ever be bravely conceived as a joyous mode of self-expression, stimulated by exultation in the triumph of mind over matter. The greedy and anxious person, unduly concerned with thoughts of self-advancement, works with divided aim, the law of the subject and the law of self-interest continually clashing, so that energy is consumed by internal friction. The best mental work involves a certain abandonment to the subject, which opens it freely to view throughout its entire panorama without distortion. It involves, also, a spirit of unselfishness which permits true objectivity, and makes one spiritually akin to all things, so that one perceives the true positive principle in all things, by which (and not by reason of defects) they exist and perform a function.

Professional pride. — When many persons become conscious of their life work as a form of art, or as a social service, and when their devotion to this work is intensified by the knowledge that many others, in the same field of endeavor, are united with them in a sort of invisible brotherhood, it is possible for their personal pride in individual achievements to be so broadened and elevated by consciousness of class that it becomes professional pride. This feeling which is so marked among scientific workers has

been, hitherto, but little developed in industry, for industry has had to contend with infinite diversity of institution, and with methods which were the progeny of tradition and makeshift. As a result of the movement to introduce scientific methods we may hope to see an industrial practice arise which, from its precision and appropriateness, will exert a charm as a true art, and will therefore provide a new center of interest to stand alongside the profit of the result, namely, the elegance of the means. As professional pride appears among business men we may be sure that two conditions are observed; that methods are based on principle, and that ultimate aims are elevated by altruism.

The human factor.—It is natural to proceed from physical problems, and from calculations as to raw materials and machinery and power, to solicitude over sanitation and accident prevention, and the laws of fatigue, and the conditions which evoke loyalty and enthusiasm in a force. As progress is made in the standardization of physical conditions, competitive endeavor must concentrate itself upon the mental and moral forces involved in the productive process. The ultimate administrative problem of socialized production is the handling of the human stuff. And science is revealing to us that this stuff is delicate tissue which must be protected not only from accident, disease, overstrain, and premature invalidism, but from monotony, apathy, and antagonism of spirit.

Ethics.—All this involves an ethical problem, because it is a question of shaping conduct in conformity with the requirements of a wide range of social reactions. We have a religious faith, with a body of commandments all embarrassingly applicable to daily life, but we have been chiefly interested to use it as a passport to a better future world. And we have a productive process which is highly social in its essential nature, but we have endeavored to operate it as a means of individual wealth-getting, under a rather meanly conceived program of every man for himself. But now "We have begun quite gen-

erally to conceive slowly a new and different type of business man," says the author of "Inspired Millionaires," "that will not have to be apologized for by always saying what a fine personality he is in private life. . . . We have made up our minds that business should not be any longer a specially marked off barbarian country, a fighting-place or cock-pit where a man can go out and crowd and bully and strike below the belt and steal for his family, and then come back into the house and put on his coat and coo to the baby and be a beautiful character until ten the next morning." [1]

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CHAPTER II

LAUNCHING AN INDUSTRIAL ENTERPRISE

The idea. — The first step in the inauguration of an enterprise is the development of the idea that there is a specific business opportunity. This idea may arise from the knowledge of an unused supply of raw materials or an undeveloped invention, from the observation of the inferiority of some article or service now holding the field, from a knowledge that certain firms are making large profits or are turning away business, or from an impression that a favorable opportunity has at length arrived for utilizing the knowledge one has gained of a particular branch of business.

Inasmuch as a sanguine disposition, coupled with youth and good health, makes new ventures seem attractive; and since there is a general tendency for minds which are "made up" to collect only confirmative testimony and neglect opposing evidence, special precautions should be taken in forming the first decisions. So prone are loving relatives to believe that one is capable of anything, and so politic are friends in leaving disillusionment to the course of events, that the business pioneer must create subjective restraints to prevent becoming overwarmed by his own initiative, or being driven by false pride arising from the consciousness of being publicly committed. One should even go further than this, and search actively for negative influences and unfavorable signs. The records of business failures show that the presumption is strongly against the average new enterprise. The power of independent leadership is rare; nevertheless the industrial community is con-

stantly harassed by the hair-trigger initiative of a vast number of ignorant and inadequately-financed individuals.

Necessary persons. — The success of most enterprises is dependent upon the quality of that small group of leading spirits which is free to assert whatever administrative talent it possesses by reason of the possession of full executive authority, and which is strongly stimulated to exertion by the pledging of estate and reputation. As this group is at first easily formed, but is difficult to alter later on, the original choice of entrepreneurs should be carefully considered. Inasmuch as talents should conform to functions, there should be included in the original group a person able to deal adequately with each important phase of the business. This would ordinarily mean a financial man to take a leading part in raising capital and in keeping the finances in order, a technical expert to plan the processes of manufacture and recommend proper equipment, a selling expert acquainted with the market to be entered, and a general executive able to formulate comprehensive policies and to hold the various lines of specialized effort in proper proportion. Under certain circumstances it may be desirable to add to the group of organizers a corporation lawyer, a representative of local banking interests, and one or more persons connected with firms which are likely to be important patrons.

As to how far proprietorship interest should be extended down the line of officers toward subordinate executives, no general rule can be given. On the one hand, there is the danger of gathering in some officious and intermeddling subordinates; on the other hand, there is no energizer like final responsibility. Mr. Carnegie once said, "I don't believe any corporation can manage a business like a partnership. When we were partners we could run all 'round corporations. You take twenty-five young men, give them an interest in the business, and each one will be looking around for the leaks."[1]

[1] Iron Age, Jan. 18, 1912, p. 197. Such an interest could, of course, be provided for promising young men in a business quite as well under the

The market and its fluctuations. — In the analysis of the market a variety of questions suggest themselves. What is the present demand for the article? If there is no active demand, as in the case of a new thing, what is the need or potential demand, judged by the relation the proposed product will sustain to present consumers' habits and to articles which are already in use? Is the article a necessity or a luxury? Will it be sold chiefly on price or on quality? Will the market be steady or fluctuating? The fluctuation of demand which must usually be encountered in supplying a luxury suggests that the production of some staple article, or article in special demand in hard times, be coupled with it. The more distant future of a projected enterprise raises the question of the manner in which the market will be effected by general movements such as the increase of population, a continued rise in the cost of living, the spread of education, the increase of restrictive legislation, any improvement in the means of transportation such as in local trucking or in suburban electric traction, the continued settling of the West, the exhaustion of natural resources such as forest resources in certain localities, etc., etc.

Price minus cost equals profit. — Examining somewhat more in detail the economic significance of a market, it may be asked, What are the current prices? If the prices seem to be very high caution should be redoubled. There is usually some catch. This is a country of active and intelligent people, and there is an abundance of capital and administrative talent on the lookout for opportunities, so that anything so obvious as a set of prices conspicuously out of line with normal profits cannot long endure. Investigation of such cases should be directed to ascertain whether demand is not seasonal, or answerable to some non-periodic fluctuation, or whether there is not some unnoticed accompanying free service rendered, or whether

corporate form of organization as by a partnership. Mr. Carnegie did, in fact, provide such an incentive in the Carnegie Steel Company, when that business was a corporation. See Chapter XIII, pp. 259–260.

there does not exist a trade group of products one element of which alone is permitted by custom to carry the profit which must suffice for the entire group. What is the depth of a market, that is to say, the elasticity of demand under pressure of an increase of supply? What increased productive capacity is in preparation, and due to become effective within a given time? From prices costs must be subtracted before profits are arrived at. The costs of a young and small establishment are not those of a large and favorably known business. It is an easy mistake for the founders of a new business to carry away with them the ratios of the established businesses from which they resign, and to apply these ratios in the estimates of a small concern which for the first few years must carry the extra costs of establishing a going business.

Policies of dominant interests. — In these days of powerful corporations and of unrevealed alliances resting upon harmony of interest, interlocking directorates, or joint banking control, it is wise for a new business to consider the extent and temper of the opposition it may have to encounter. Some of our great interests have admirably preserved the peace with their smaller rivals, but others have waged a warfare of extermination. Intolerance may be shown through the monopoly of basic materials, through the trade ostracism of exclusive buying and selling contracts, and through "predatory competition." Predatory competition is a plan which can be followed by a corporation which covers an extensive territory in dealing with a competiton whose operations are confined to few localities. It consists in reducing prices at competitive points to a figure which destroys profits, and in elevating prices at non-competitive points sufficiently to recoup the loss. American law has not yet devised a protection from this savage policy.

Scale of operations. — The proper scale for initial operations is a function varying with the degree of certainty of ultimate success. Where experienced persons, backed with ample capital, enter upon the production of a staple article, the first

object may reasonably be the purely capitalistic one of attaining the economies of production on a large scale. But where the establishment of a new enterprise involves the trying out of a number of experiments as to processes or selling plan, the initial scale of operations should be as small as will yield the desired experimental knowledge. Such a business should aim to be at first as purely as possible an enterprise selling personal service, until the experiments show that it is safe to use capital in it freely. A strong element of uncertainty always means that investments of a permanent and specialized character, such as those for buildings, machinery, and manufactured stock, should be kept at the minimum; and that long-term contracts for materials, for the services of high-priced experts, or for the use of patent rights, should be avoided. It is sometimes possible, in making a beginning in manufacturing, to contract for such parts or for such semi-manufactured materials as require expensive plant, or as involve in their production only ordinary converting profits.

Partnerships. — The partnership relation has many disadvantages for a business which is to use much fixed capital, or in which individual transactions may involve the creation of large liabilities. The partnership does not create an artificial person, but merely establishes a limited set of relations between natural persons. Each partner is an agent able to bind the others with respect to all regular matters, such as the buying and selling of stock in trade, the employing of servants and agents, the borrowing of money, or the issuing of negotiable paper, and the compromising or releasing of claims. While the acts of a partnership are in the name of the firm, the responsibility created is individual, and usually unlimited, no agreements between the partners to limit this liability having validity as against the claims of outside uninformed parties. When, therefore, one member of a partnership is negligent, or commits a tort, or is guilty of a fraud, within the scope of his authority, his partners are equally liable with him, financially. In the con-

duct of the ordinary affairs of a partnership a majority of persons governs: while, in case of any important departure in policy, any dissenting member can oppose an effectual bar. No partner can compete with his firm, nor can he, without express permission, sell to it, or buy from it, or otherwise deal with it as an outsider, without rendering himself liable to the others for an accounting of profits. Interest in a partnership is not transferable without unanimous consent. Unless there is an agreement to the contrary, the death or withdrawal of a member dissolves the partnership. A partner may even be held responsible for the acts of a firm after he has withdrawn from it if any third parties, not having received notice of his withdrawal, deal with the firm relying upon his continued liability.

The corporation. — An industrial corporation is a collection of natural persons empowered by law to perform a designated range of industrial acts, and to enjoy the facility of operating as a unit or artificial person. The members of a corporation can contract, hold property, and sue and be sued in the corporate name. They may possess a common seal. They may frame by-laws for their own government. They have the power of continuous succession, during the prescribed period of corporate existence. In contrast with the partnership, a corporation has the advantages that it cannot be dissolved by the act of an individual member, that its members are not agents unless specially appointed, and that the liability of the shareholders is limited, as a rule, to the par value of the stock held by them; managerial control lies with a majority of the shares. The stocks and bonds of a corporation possess many advantages as investments for persons who do not desire to be active in management. For this reason a corporation has an advantage over a partnership in raising capital and in borrowing money.

The corporation charter. — The drafting of the charter of a corporation is an important matter, inasmuch as only such powers are possessed by a business as are expressly conferred,

or as are implied in the realization of its avowed lawful objects or by reason of its existence as a corporation. An industrial corporation has, usually, the implied power to borrow money, to appoint agents, to issue negotiable paper and receive the same in payment of debts, to take and hold property in trust and execute the trust when conformable to expressed objects, to purchase and dispose of its own stock, and to purchase and hold as much land as may be necessary to accomplish the purposes of its creation. It has not the power to lend money, except surplus funds, unless banking powers have been conferred. It has not the power to become surety for another, unless it be given the franchise of a surety company. Nor has it the implied power to take the stock of another corporation, except for debt or in payment for goods, and then only with the intention of selling it and not of holding it. A manufacturing corporation cannot engage in buying and selling goods, except as this may be necessary or incidental to its declared object. A corporation empowered to manufacture one kind of goods cannot manufacture other kinds. A trading corporation empowered to buy, sell, and hold certain kinds of goods cannot trade in other goods. Any action of a corporation beyond the scope of its authority is *ultra vires* and void. An injunction against such contemplated action may be secured by a dissenting shareholder.

In drafting a charter two rules of legal terminology should be held in mind. (a) The express mention of a thing is tantamount to an exclusion of other related things. (b) When a general term follows a special term it is held to apply only to the kind or class of thing which has been specially mentioned. Thus, a corporation authorized to carry on "a business of mechanical engineers and general contractors" was held only to have the power to do such acts of "general contractors" as it was usual for "mechanical engineers" to perform.

Local capital. — New concerns of small size, known only near home, will usually be dependent upon local capital. The

local investor has a natural advantage in keeping track of his interest. This makes the local man of means the logical patron of new small enterprises. It is, as a general rule, easiest to raise money for a new establishment in those localities which have already before them the example of successful establishments in the same line. As a rule, also, an individual will more easily make a new investment in a line of industry in which he has previously had success, than in an untried line.

Trustees. — When investors do not constitute a local group, able easily to keep in touch with the progress of launching, it is advisable that subscriptions to stock should be deposited with a financially responsible trustee, such as a bank or trust company, which trustee is bound by the terms of a carefully drawn agreement. Such an agreement should provide that, if sufficient funds are not subscribed within a given period to make the undertaking possible, the money of subscribers shall be returned to them, less an agreed percentage allowed to cover the expenses of promotion. Upon receipt of sufficient funds, the trustee should be empowered to apply them for explicitly designated purposes, upon the presentation of vouchers drawn by the proper officers, and under a system of inspection calculated to insure the honest use of the funds for the intended purposes.

The promoter. — If the leading individuals in an enterprise have not the time or the talents for the work of promotion, it may be desirable to employ a professional promoter. Promotion in recent years, in this country, has become a business in itself. A class of men has sprung up to serve as middlemen or intermediaries between men with money to invest, and men with undeveloped property or unutilized ability which is for sale. The less influential of these middlemen employ themselves chiefly with the functions of stock and bond salesmen, organizing campaigns to dispose of securities. The standard promoter, however, is an expert in assembling a proposition. This he does by securing options upon the necessary property, and by

working out the plans of organization and operation far enough to reveal the significance of the project to the capitalists who are to be approached.

Syndicate managers. — The highest class of promoters is composed of the representatives of syndicates of banks and groups of large private investors. These persons, after making rigid investigation, recommend the financing of the propositions they approve to the moneyed interests which depend upon their judgment. The financing which syndicate managers provide usually takes the form of the purchase of a block of securities of the newly organized corporation at special prices, care being taken to secure sufficient representation upon the board of directors. When the financed corporation has established a record of earnings so that the market may be trusted to take care of itself, or when the period within which it was undertaken to control the market has expired, the syndicate members may dispose of their securities, making such profit as they can above the purchase price.

Engineering promoters. — There are in existence a number of promoting corporations which have, in addition to the usual financial machinery, a corps of engineers able to take charge of construction, and a corps of administrators able to supervise going businesses. These promoting engineers are able to pass upon propositions the analysis of which demands engineering skill. Upon accepting a project they construct the works and receive their pay in securities. They then either sever connections by selling the securities, or continue in the control of the management as the representatives of investors affiliated with them. Engineering promotion of this character is now important in the building and operation of irrigation works, street railways, water-works, gas-works, and plants furnishing electric light and power.

Application of funds. — The funds in the hands of a new business must be allotted in such a way as to cover various classes of requirements. A portion will go into fixed and rela-

tively permanent forms, such as buildings, machinery, and office equipments; another part must be reserved for raw materials, finished stock, pay roll, credit advances to customers, and other rapidly changing forms of investment. This classification brings into view the contrast between fixed and circulating capital, with regard to which the following points should be noted.

1. Circulating capital is that which encounters frequent liquidation, or change in the character of the property which represents the values. The opportunity of changing the form of investment frequently occurs. Fixed capital requires considerable periods of time for the wearing out of the property and the gradual release of the values for reinvestment. As the values disappear from the original fixed forms they find existence, in transmuted form, in the increase of the values of the materials worked upon. Liberal fixation of capital is appropriate only for enterprises of a permanent nature.

2. Fixed capital may be of various degrees of specialization. Specialization may be of form (only useful for certain purposes) or of place (only available for enterprises which can accept the location). When a factory is built in a thriving city, and is of standard loft design and arrangement, so that it can be turned to a variety of manufacturing uses, a considerable portion of the values locked up may be recovered by sale, if the original project fails. If, however, a plant is located in the country, and is strictly specialized for one purpose, if that use fails, the loss is heavy. The degree to which capital should be specialized is a function of confidence in the soundness of the nature of the project and of its location.

3. The recovery of the values in fixed capital is a process requiring the continuous supplying of circulating capital. Materials, labor, and repairs must be provided to support the productive process; and without them the values locked up in fixed forms will be wasted. Mr. James Hartness has said, "A plant and business is useless when not in motion, and when

under headway requires money. Money must be poured into it steadily to an amount which, every year, generally equals the total capital in the business. Much time and energy have been consumed in careful consideration of the cost of the plant, but not enough thought has been given to the money tied up in the business in other ways."[1] In short, as Poor Richard said, "It is easier to build two chimneys than maintain one in fuel."

4. To a limited extent there is a reciprocal relation between the amounts of fixed and of circulating capital required to carry on a productive process. A factory building of concrete has a lower insurance and maintenance charge than a frame building. With sufficient mass of traffic, a well-built railroad will attain lower ton-mile costs than a cheaply built one. The normal balance between fixed and circulating capital is reached when the saving in operating expenses to be effected by the next increment of fixed capital is equal to the fixed charge which that increment will create.

5. There is danger in the launching finance of underestimating a certain class of necessary expenditures which result in the intangible forms of capital bearing the names "good will" and "going value." Among such expenditures are the costs of organization, of introducing a new product to the trade, of maintaining a state of productive efficiency during the initial period of waiting, and of learning many kinds of wisdom by experience.

Voting control. — In the early financing of a business the question of control is constantly involved. In the day of small things a few hundred dollars may decide where control shall rest and, if growth is later made from undivided earnings, and if successive issues of stock are made proportionate to holdings, such early investments may decide in whose hands large ultimate values shall rest. By the use of preferred stock to represent money and property contributed, and common stock to

[1] Human Factors in Works Management, N. Y., 1912, pp. 133–134.

represent services, patent rights, etc., it is possible to adjust voting control in any desired manner among a group of persons.

Time of flotation. — The business of the country passes through a succession of trade cycles of uncertain length, but averaging, perhaps, ten years. The order of changes in a cycle may be indicated approximately as follows:

1. Money is plentiful and interest rates are low.
2. Gilt-edged securities rise.
3. Speculative securities rise.
4. Commodities of short life rise in price. Business prosperity.
5. Commodities of long life, such as real estate, the value of which is partly a forcast of future earning power, rise.
6. Money becomes scarce and interest rates are high.
7. Gilt-edged securities fall.
8. Speculative securities fall. Crisis followed by depression.
9. Commodities of short life fall.
10. Commodities of long life fall.

1\. Money is again plentiful and interest rates are low.

It has been suggested, on the basis of the trade cycles, that the financing of new enterprises, or of extensions of old ones, may be most advantageously carried out during periods 3 and 4, while securities are still being absorbed freely at high prices, and before a panic breaks. The money so raised can then be applied in providing equipment during the ensuing depression, while the prices of materials and labor are low. The aim of a launching plan thus timed would be to prepare for business slowly and thoroughly, to try out processes, select the cream of the labor market, establish discipline, and settle all factors into a smooth working order, so as to be ready to take advantage of the first recovery in demand.

Mr. Matheson has said: "If [an establishment] is transferred at a time of high prices, the real value depends mainly on the readiness of the factory. If, because of high prices, capitalists begin to build new works, it will often be found that by

the time they are ready prices have fallen, probably because new factories have increased the productive power, or even because the mere prospect of new factories induces competitors to lower their demands. It is in a time of deep depression that prudent purchasers will often find the best opportunity for buying or building a factory." [1]

The method of financing should be adjusted to the stage of the trade cycle. In the beginning of an optimistic expansion bonds may be offered to good advantage. At a later time, when speculative enthusiasm is strong, stocks will yield better returns. During depressions short-term notes may be issued, if the credit of the issuing corporation is high. The financing plan may be adjusted to the conditions of the money market and the security market by varying the proportion, rate of yield, term, denomination, and guaranteed rights of the securities issued.

Processes. — A preliminary study of the steps of manufacture should be made with the utmost thoroughness. If new processes are to be introduced, it must be determined whether the apparatus deserves patenting, or whether any feature is to be preserved as a trade secret. In this connection a word of warning may be dropped. Successful processes or apparatus are usually a matter of slow growth. A new mechanical contrivance, which is to be offered to the public as a consumer's good, is usually in a crude state when patented; it is almost never brought to perfection until the designer's original idea has been thoroughly revised in the light of shop experience in production and consumer's experience in utilization. Furthermore, an American patent, covering an idea of real value, has been defined by those who have had experience as a "license to litigate."

Buildings and equipment. — It is only on the basis of the exact determination of the nature and sequence of manufacturing processes that the character of the buildings, machinery,

[1] The Depreciation of Factories, 3d Ed., London, 1903, pp. 114–115.

yard spaces, track connections, and general lay-out of an establishment can be specified and contracted for. There are two difficulties with reference to equipment which lie in wait for a new concern. The first is that articles must be bought by persons who are more or less inexperienced, and of whose ignorance certain supply dealers are willing to take advantage. The second is that the new equipment must be tried out by a force not yet seasoned to its duties nor accustomed to working together, with the probable result of low speeds, heavy wear and tear, considerable spoiled work, and numerous accidents.

Second-hand plant. — The advice of men of experience is against the purchase of second-hand plant or machinery. The record of a failed concern casts an unpleasant shadow upon a new tenant. An establishment of old design, built with a different original purpose in mind, imposes many limitations of arrangement, lighting, heating, ventilation, fire hazard, and power supply. The exact state of old equipment is hard to judge, not only with reference to physical condition, but as to how obsolete it is in comparison with new models. The buyer of new machinery can rely upon coming fairly abreast of the evolution of machine design. With such purchases comes the maker's original guarantee. By patronizing firms of established probity and technical efficiency, much help will be received in the way of expert advice as to the best models to select for the purpose in hand, and in the form of preliminary instruction in the methods of operation.

There are exceptions to the rule that second-hand equipment is not worth while. In businesses like ore concentration and reduction, where sudden changes in the nature of the ore body may require the rebuilding of a mill, or in the shipping industry, where the opening of canals or changes in tariffs or mercantile marine legislation require changes in the nature of the vessels on certain routes, it is possible to buy second-hand equipment which is in good condition and free from the stigma of failure. Again, in businesses like most of the public service industries,

where duplicate equipment is required to insure continuous operation in case of breakdowns or repairs, second-hand apparatus will often answer adequately the purpose of stand-by equipment to be used as a reserve for emergencies.

Managerial staff. — It goes without saying that, as the general scheme of functions of a mechanical, mercantile, and financial nature is conceived, steps should be taken to clearly define the various classes of executive duties, and to group them in such a way that there will be arranged for each person a consistent range of functions, and that these persons will be bound together in a well-balanced administrative hierarchy. It is an advantage to record the administrative determinations on a chart of authority, as they are made to insure that every necessary duty has been assigned, but that no one is overloaded. Unless a beginning is made with clear-cut decisions and adequate records, a confused temporizing habit of muddling along will be established, which will be difficult to break, not only because of the subtlety of the repressed attitudes but because of the sensibilities which must be regarded in carrying through anything which has the appearance of a "shake-up."

The labor force. — A new business, having no men of its own training, must face the problem of gathering rapidly a complement of skilled workmen and capable foremen. Men who come together from various shops, bringing with them different ideas as to speed and method of work, as to the etiquette of foremanizing, and as to shop rules generally, have to be brought into harmony with strange policies and become adjusted to an inexperienced staff of superior officers. A new management tends to fall heir to the riff-raff of the labor market, which is ever moving on to the new employer for reasons best known to the old. Among the undesirable types, aside from the dissipated and obviously unfit, are those restless persons who never remain long in one place, those enterprising young men who represent themselves as skilled while they are "stealing a trade," those who are always financially embarrassed and ask

for advances and assign their wages, those who try to obtain employment through influence, those who justify themselves by attacking the character and methods of previous employers, and those men of capacity who have turned sour and become trouble makers from enmity for all placed in authority. The employment officer should be a first-class man, for out of the rank and file will come the future foremen, and department heads, and junior partners.

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CHAPTER III

LOCATION OF AN ESTABLISHMENT

Location determines, to some extent, the efficiency of every economic factor. Much progress has, undoubtedly, been made in a generation in evening up local inequalities, and so in reducing the significance of the factor of location, by the standardization of machinery and factory buildings, the leveling of wage rates and interest rates, the wide distribution of technical information by the trade press, the more uniform operation of the agencies of education, and by the standardization of habits of consumption over wide areas. But locality still exerts a decisive influence on the accessibility of raw materials, convenience to markets, and the degree of rivalry and emulation under which men work. The smaller an establishment the more significant is the question of location to it. A small establishment has chiefly a local market, and appeals only to near-by investors. It is compelled also to employ outside service industries to perform a wide range of functions for it, and so flourishes or suffers according to the completeness or incompleteness of the local equipment. A large concern, on the other hand, can be more self-contained, because it will support its own service departments. Such a concern, being more widely known, can look farther afield for capital and managerial talent. Its mass of capital and its extensive personnel enable it to exert a transforming influence upon its neighborhood. Whatever the significance of location may be, in any individual case, that influence is made well-nigh irrevocable, when once determined, by the difficulty of moving.

Wellington's rule. — Mr. A. M. Wellington, the author of "The Economic Theory of the Location of Railways"[1] has laid down the rule that the best location for any economic unit is the one which yields the largest difference between capitalized gross income and total capitalized cost. While this seems to be nothing more than a financier's way of saying that we should locate where the most valuable results can be achieved with the least outlay, Wellington elucidates the special significance of the rule by calling attention to the fact that the costs which must be kept in mind are not simply the individual or internal costs of an establishment, but the entire chain of costs involved in bridging the gap between the supplies of raw materials and the consumers of the finished products. Thus, a plant should be placed, not where the making costs are least, but where the sum of the costs for raw material, transportation of the same to the plant, manufacture, selling, and the transportation of finished product to market will total the smallest possible sum, considering the market to be reached.

Nearness to materials. — There are a variety of factors entering into material cost. Besides the obvious matters of original purchase price, buying expense, and transportation rate, there are such items as the expense of the reserve stock which must be carried at the plant to allow for irregularity of supply, and the extra converting expense caused by lack in range or dependability of quality. The effect of reliability of supply and of a wide assortment from which to select is frequently so great that an establishment will prosper better in a great market than in a region of original supply. The ideal location with reference to materials is the one where all factors combine to make the lowest possible raw-material cost per unit of completed product. The test is not the cost of a unit of materials laid down, but the material cost of a unit of completed product. In the latter figure the relative importance of the different materials involved in the product is brought

[1] N. Y., 1887.

to a final balance. The location of perishable or bulky materials will, of course, exercise a special effect upon material costs.

Beyond the effect of location upon the supply of such materials as are specifically required by an industry as its raw materials, there is the broader effect resulting from the presence or absence in the neighborhood of those natural resources which are requisite for the well-being of a body of people. The cost of a raw material depends not only upon the crude resource which is to be directly exploited, but upon the local cost of labor, capital, and management. The cost of these factors will in turn depend upon whether there is an abundance or scarcity of the things required to maintain a satisfactory standard of life. It is said that there are many rich ore deposits known in the West which are unexploitable because of inaccessibility. This inaccessibility really means that those ores are in a region bare of the resources required to support life. The difficulty lies not so much in getting the ore out as in getting supplies in to the workers. If a raw material lies in a region where timber is scarce, so that wood must be brought a long distance for houses; if there is no coal near by, so that power is expensive; if there is lack of water, so that agriculture is impossible, and the food of men and horses must be brought in by train and pack trail; if, in short, the material which is the object of calculation is unassociated with the other materials upon which industry depends, it will need to possess extraordinary quality and quantity to develop any value, for the high costs will fix the margin of exploitability at a high point. The value of any resource or raw material in a given location is partly the reflected image of the general fitness of that region for life, industrial effort, and civilization generally. The great resources which make most regions prosperous are a fertile soil and an adequate climate to provide cheap food, good steam coal or water power to give low-priced power, and adequate structural materials to make the cost of housing moderate.

Nearness to sources of power. — In so far as power is transformed coal, oil, or gas, the advantage of location with reference to these materials will imply advantage with reference to power. Location close to water power will be attractive for continuous-process industries, like flour milling or paper manufacture, and for industries, like pulp mills, which must locate in remote districts where transportation rates on coal are high. The advantage of locating where public service industries furnish electric power consists not so much in the price per horse-power year, as in the fact that capital does not need to be invested in power plant, and that with a fluctuating load the expense for power rises and falls more closely in conformity with the amount used than is the case when a private power plant is maintained.

Miscellaneous natural advantages. — A healthful and invigorating climate, free from such violent extremes of temperature as make out-of-door operations difficult, and without that excessive fluctuation from humid to dry which disturbs the physical condition of materials in process of manufacture, is of advantage to industry. The violent fluctuations from which the central portion of the North American continent suffers make necessary special precautions in the way of building construction, and of systems of heating and ventilation, to maintain the health and energy of operatives. Inasmuch as the prevailing winds in the northeastern portion of the United States are from the west, it is wise for factories producing articles prized for their immaculate character to locate on the west or windward side of cities where the air is free from dust and smoke.

Labor supply. — The supply of unskilled labor in a district is a tolerably simple function of the mass of total population. Difficulty in recruiting a labor force centres upon the higher ranks of craftsmen and the lower ranks of clerical and administrative staff. Our chief dependence for skilled laborers is at present immigration. The cities of the eastern seaboard, and the cities of the North Central states which are located on the Great Lakes, have an advantage in first choice from the incoming

human stream. This advantage has served, until recently, to congest manufacturing unduly in the northeastern section of the country. As between cities of similar geographical position and attractiveness as labor markets, the distribution of foreign-born artisans depends upon the accident of the formation of a colony of persons of the same race, language, and nationality, and possessing a size sufficient to satisfy social instincts.

The reliance of the future for skilled labor must be increasingly upon specially adapted educational institutions. American employers have not yet generally perceived the profit of local trade schools, as have the Germans. There seems to be a fear that a community which supports a special type of school will find itself paying for the education of young men of other neighborhoods. But a trade school is a device for skimming the cream of the youthful talent of the surrounding region and putting it at the disposal of the employers nearest at hand. The local employer enjoys the opportunity of making first choice from the exceptionally capable youths who have had the enterprise to leave home in search of an education.

As between city and village, in the matter of labor supply, it may be said that the large centre presents the advantage of the more highly skilled labor, and of the larger supply of floating labor available for temporary requirements by simply hanging out the card "Help Wanted." The small place offers a more steady and devoted force, and one the members of which are better acquainted with each other, and so more disposed to team work. Village labor is of good general intelligence, and not easily influenced by agitators who plan industrial disputes. And this supply the village offers at lower wages, corresponding to the lower costs of living.

Capital. — There is an economic geography of the supply of loanable capital, and of the activity of financial institutions, as there is of raw material or labor supply. Every one knows that, in a general way, a loan or investment transaction which in the East would pass at 5 per cent, would require 6 per cent in

the Middle West, and 7 per cent in the Rocky Mountain and Pacific states. More important to an individual business concern than the general level of rates throughout the country is the fact that in small money centres the banks and investors are prepared for small transactions only, dealing in money at retail, while in large centres money is dealt in at wholesale. Retail prices are higher than wholesale. It is desirable, therefore, that an industrial institution should carry its financing to the largest financial market upon which it can establish a standing. In behalf of the bankers in small places it may be said that they have a greater sense of individual responsibility to take care of local enterprises than have the banks of the larger centres.

Association with other industries. — Competition between business establishments is a point so much emphasized, and this competition is so usually interpreted as if it were a state of pure antagonism, that the truth is often overlooked that industries usually thrive best in groups.

1. A number of similar concerns in a locality can usually secure materials to better advantage than any one can do single. An illustration is the Chicago Union Stock Yards, supported by a number of packers, and able to absorb train loads of cattle without breaking the price. This steadiness of price or "depth," which one firm alone could not insure, is what gives confidence to cattle men and promotes liberal shipments. The concentration of a number of similar establishments serves to increase the variety of materials which can be offered by suppliers. This may be illustrated by a textile weaving centre such as Philadelphia. Because the spinning mills located in all parts of the East and South have selling agents there, manufacturers who desire to make mixed fabrics or specialty cloths find that neighborhood a good one to locate in, because they can there secure yarn of any material, size, color, and tightness of twist, at a moment's notice.

2. Concentration of establishments, even of a like kind and direct competitors, improves the labor market, both for

employer and employee, in many ways. The city of Grand Rapids, Mich., has become a veritable training school for cabinet makers and furniture designers and salesmen. Even the public library of Grand Rapids has specialized, for it contains one of the best collections of books on furniture in existence. East Liverpool, Ohio, has become an objective point for English potters. The potters who are on this side keep up the supply by writing back to their friends in "the five towns," telling them where to migrate. A locality preëminent in any line draws to itself such skilled workmen as lose their positions elsewhere and are averse to changing crafts, and such specialists as feel safer in a locality where there is more than one possible employer.

3. In specialized centres the banks become familiar with the requirements of the dominant industry. They learn the standing of the firms in the trade, and can more readily and safely discount the special line of commercial paper. And, if their resources become overtaxed, the recognition of their expertness by banks elsewhere makes it easy for them to rediscount.

4. A group of plants can jointly produce such a demand as will cause a variety of repair and supply industries to establish themselves nearby, such as foundries, machine shops, pattern makers, mill supply houses, laboratories, mill architects, and designers.

5. Carrying the division of labor a step further, a specialized industrial centre adds to the service industries various part makers and assemblers who, by concentrating upon special kinds of work, reach a high perfection. The presence of these concerns makes it possible for a new enterprise to confine itself at will to a restricted field, corresponding to its capital or technical ability.

6. Finally, a group of similar or related manufacturers established in one place serves to perfect their local market. The reputation of each firm supplements that of others, until the name of the town becomes almost a trade mark, and a firm

enjoys prestige from the mere fact of location in the noted place. South Bend suggests wagons; Troy stands for collars and cuffs; Holyoke, Mass., signifies water power equipment; Grand Rapids means furniture, and Detroit automobiles. To such markets

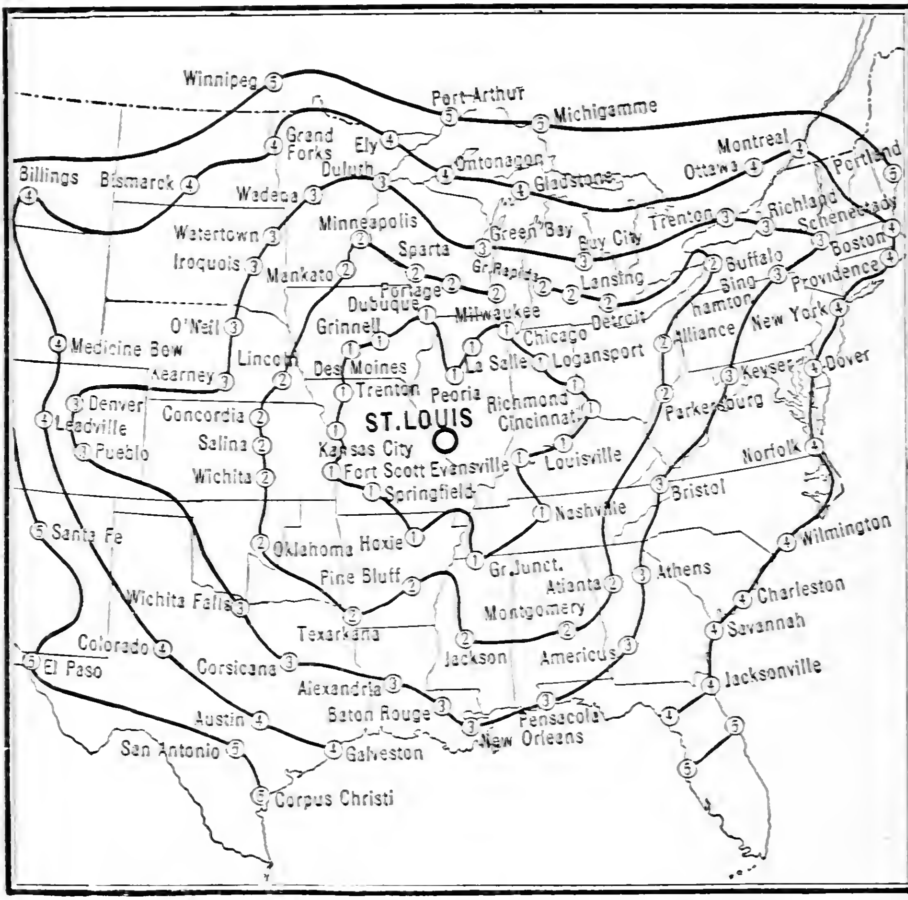

Fig. 1. Distance in Terms of Time

The map shows the average number of days required for package freight from St. Louis to reach the indicated destinations.

consumers, dealers, and would-be agents are attracted, and the general rule that the seller must seek the buyer is, to some degree, reversed. A large specialized market is able to afford various service industries which have to do with trading functions,

such as packers, insurers, forwarders, professional graders, commercial photographers, and trade papers.

Economic geography. — In the calculations of economic geography, it should be remembered that commercial distance is not physical distance. Commercial distance is not measured in miles but in terms of cash outlay, time expenditure, risk, inconvenience, and the mental inertia to be overcome. It is a complex of many factors; and since it is not a simple factor there never can be any such thing as a complete economic map. It is possible to represent the freight charges of a single class rate from a single centre by a map, but such a map will not correctly represent the relative positions of the places as viewed from other centres of shipment, much less make allowance for such factors as time in transit, frequency of train and car service, and convenience of terminals. To distinguish clearly the economic geography of a region from the physical geography, and to conceive truly the highways of commerce, and the forces which impel or retard the movement of goods and persons over them, is no small revolution of one's customary ways of thinking of space relations.

Location and freight rates. — The classification rules and the freight rate structure of American railroads show that the strategic places for the location of industries which involve important assembling and distributing functions are, (*a*) points on competing water-ways, especially ocean ports and Great Lakes ports, (*b*) centres at which numerous competing railways converge, (*c*) locations within influential common-point territory, adjacent to the previously mentioned centres, and, (*d*) localities so influential in the supply of certain products as to enjoy favorable commodity rates on those articles.

Natural protection. — There is, of course, a limit to the advantage of any single location. As distance increases, transportation expenses form an increasing natural protection, insuring to a distant competitor relative advantage in his neighborhood. It has been found, therefore, that in the support of national distributive campaigns it is often necessary

to operate a series of plants, locating each establishment in such a way that it will command the trade of a district. To whatever office orders may be sent, they can then be filled by the plant nearest the customer. Cross shipments can be avoided; excess stocks can be shifted; and accidents and other interruptions localized.

The local market. — The tendency of our commercial evolution seems to be to break down the distinction between a manufacturing East and an agricultural West, and to develop in each region manufacturing and jobbing centres for the supply of the territory lying about them. The importance of intensive cultivation of local territory is, therefore, increasing.

Estimates of population. — The market which a community affords for consumption-goods depends upon the population, its wealth, and its habits of life. There are various methods in use for estimating population between census years.

1. The rate of growth between the last two census periods can be calculated, and assumed as continuing unchanged since the last census. This is a very unsafe method, as will be seen when it is observed that Detroit, which increased 77 per cent between 1880 and 1890, in the next decade increased only 38.8 per cent, but in the decade 1900–1910 increased 63 per cent. Chicago, which increased 118.6 per cent between 1880 and 1890, in the next ten years gained only 54.4 per cent, and in 1900–1910 only 28.7 per cent.

2. The endeavor is sometimes made to calculate the population from the number of votes cast at elections. The chain of relationships here involved (using percentages based on the election records of November 1900 for all cities over 50,000 in population) is:

Percentage of males in the total population	50%
Percentage of adult males in the male population	60%
Percentage of citizens in the adult male population	89%
Percentage of votes cast to citizens	72%
Percentage of votes to total population	19%

This gives a ratio of one vote cast for every five inhabitants. The method is unreliable, however, because of the varying interest in elections.

3. Estimates can be made on the basis of the names in the city directory. The ratios vary from 1:1.8 to 1:2.8, with an average for twenty eight large cities in 1900 of 1:2.31. Uncertainty arises from the fact that there is no settled practice with reference to the insertion of the names of married women, and from the further fact that the age at which the names of young persons are admitted varies in different directories from sixteen to twenty-one years.

4. The population of school age may be used. The general ratio is approximately one school child to $3\frac{1}{3}$ persons in the total population. But the population of school age is variously defined in different places, the lower age limits ranging from four to eight years and the upper ones from fourteen to twenty years. The diligence and accuracy of boards of education in census taking are, of course, variable factors.

Tributary territory. — The extent of the surrounding region which is tributary to any village or city is not easily determined. The experience of travelling salesmen, retail merchants, banks, and railroad ticket agents is valuable, but difficult to collect. Rough calculations can, of course, be made from census data, distributing the rural and village population between competing points on the assumption that the attraction of rival centres is inversely as the square of the distance and directly as the size. Accurate mapping of tributary territory has as yet been done rarely by American cities. The business men of the city of Delevan, Wis., have determined the limits of the influence exerted by their city, by an actual canvass. A reproduction of the map resulting from their work may be found in the World's Work for February 1913, page 468.

A somewhat different analysis of tributary territory abandons the map method of presentation and tabulates the population accessible at given freight rates.

Style movement. — It is not natural that the people of a community should purchase style goods from a market which

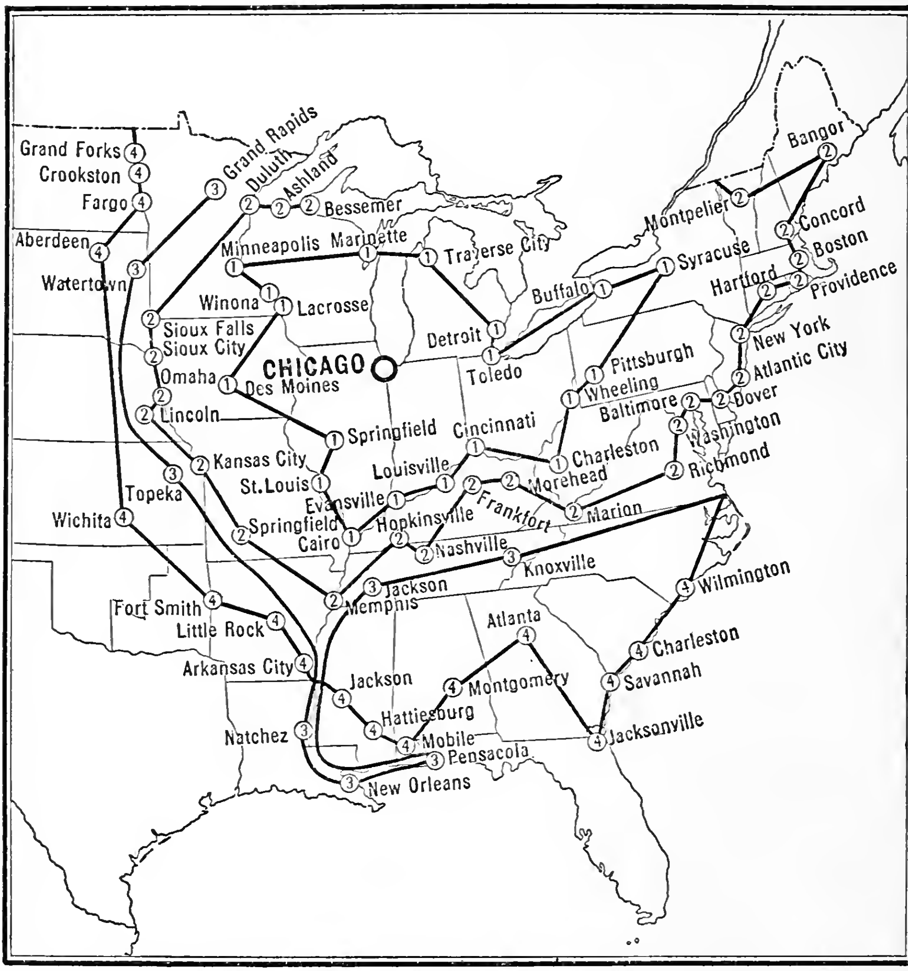

Fig. 2. Distance in Terms of Cost

The map shows the cost of shipping 100 pounds of first class freight from Chicago to various destinations. To points marked **1** the freight charge is between \$0.40 and \$0.60, to points marked **2** it is between \$0.65 and \$0.85, to points designated by **3** the charge is between \$0.90 and \$1.10, while to points **4** it is between \$1.15 and \$1.35.

they believe to be one receiving new ideas later than themselves. The law of style movement in the United States is that a new idea passes from east to west, from larger cities to

FREIGHT RATES AND TRIBUTARY POPULATION

The following statistics compiled by the Commercial Club of Kansas City, Mo., show the population within reach of certain commercial centers of the West, at specified freight rates.

City	Rate in cents not to exceed	Population	Rate in cents not to exceed	Population	Rate in cents not to exceed	Population
St. Louis	26.66	1,462,778	44.84	6,059,966	50.16	9,456,625
Kansas City ...	27.56	1,227,077	45.75	3,971,522	56.50	8,143,225
Omaha	25.06	481,237	45.79	3,779,946	54.02	6,227,728
Memphis	24.56	258,940	44.14	939,825	53.76	2,889,674
Dallas.........	28.57	496,587	39.93	973,437	53.65	1,522,045
Denver	20.82	280,188	30.11	348,837	52.45	556,696

smaller ones, and from neighborhoods of wealth to those of less wealth.

City measurements. — The statistics of industry have now been so much improved that persons who are choosing a location for a plant can supplement personal observations by comprehensive measurements, in many cases. With reference to taxation it may be asked, Does the per capita taxation of the place under investigation vary much from the average of $12.02,[1] which is normal for cities of 30,000 to 50,000 population, or from the average of $13.56[1] for cities of 100,000 to 300,000 population, or from $22.87,[1] the average of cities of over half a million inhabitants? What is perhaps more pertinent, is the question, Is the rate of taxation per $1,000 of assessed valuation $15, or $20 (which latter figure is approximately the average of northern cities), or is it $25 or $30? And, further, is the assessed valuation 100 per cent of the true value, or 25 per cent or 50 per cent or 75 per cent?

Are the water rates 10 cents per 1,000 gallons (which is a fair average rate), or are they 3 cents with Philadelphia, or 4 cents

[1] Statistics of 1913. See Statistical Abstract of the United States, 1914, pp. 560–563.

with Cleveland, or 25 cents with San Francisco, or $33\frac{1}{3}$ cents with Tacoma?

Is gas sold at the usual price of 90 cents per thousand feet, or does it run as low as 70 cents in emulation of Los Angeles, or as high as $1.40 to equal Spokane?

Is there evidence of normal growth by annual building activities involving a per capita expenditure of $30.00, or is there temporary stagnation such as Lowell, Mass., experienced with but $8.82 [1] invested, or a boom such as carried Detroit's outlay up to $58.53 [1]

Is the city's annual fire losses at about the American 1914 average for cities of over 20,000 population, namely, $2.32 per capita; or do these losses fall under $1.00, so that the locality is one of the 65 honor cities, or are they over $5.00, and so in the class of the 30 worst offenders against life and property?

Finally, do the bank clearings of a city of 100,000 to 125,000 population average $1,665[2] per capita, or are they low with Lowell at $353,[2] or high with Houston, Tex., at $4,895[2]? If the city is of 300,000 to 500,000 population are the clearings an average figure at about $2,952 [2] per capita, or are they down with Washington, D. C., at $1,115,[2] or up with San Francisco at $5,673,[2] indicating a great commercial center?

Other statistics which are worth while considering are bank deposits, and especially savings deposits, as an index of the well-being and thrift of wage-earners, post office receipts,[3] the percentage of home ownership, whether or not the sexes are equally balanced, and the death rate. President Nicholas Murray

[1] Statistics of 1913 are taken as more normal than those of 1914. Statistical Abstract of the United States, 1914, pp. 174–175.

[2] Statistics of 1914. The averages are based on the clearings of 10 cities of 100,000–125,000 population, and on the clearings of 10 cities of 300,000–500,000 population.

[3] The post office receipts of 15 cities, chiefly in the South and West, and ranging from 2,000 to 91,500 population, averaged for the ten months ending September 1915, the sum of 37 cents per capita per month. The range was from 10.5 cents in Fall River, Mass., to 81.8 cents in Dallas, Tex.

Butler has said, "Where the public school term in the United States is longest, there the average productive capacity of the citizen is greatest." The percentage of children of school age who are actually in school is important as it is an evidence of the quality of the labor force which is in preparation for to-morrow. The severest test of the school system is the percentage of the children of foreign-born parents who are in school. The Census of 1910 indicates that under good conditions approximately 90 per cent of such children, from 6 to 14 years of age, should be enrolled in school. Some of the honor cities are New Haven, Conn., Cambridge, Mass., Denver, Colo., and Boston, Mass. Bad conditions exist where less than 80 per cent are in school. Some cities with poor records are New Orleans, La., Scranton, Pa., Baltimore, Md., and Memphis, Tenn.

Factory sites. — The exact location of a factory involves the consideration of a class of real estate for which the standards of value are not as definitely fixed as they are for mercantile or residence property. The erratic fluctuation of the prices of manufacturing sites is due partly to the fact that the market is not active, and that the property involved is commonly located on the outskirts of cities where speculative prospects determine values, rather than the capitalization of current income-producing power. The price of speculative property varies with the vividness of the imagination of the holder, and with the state of local excitement created by recent transactions. Another reason for the uncertainty of values is that a wide variety of real estate conditions is involved, ranging from central-district property, in plotted areas, on paved streets, with trackage facilities, and enjoying fire, water, and police services, to distant swamp land, dealt in on an acreage basis, and suited for little else than the dumping of manufacturing wastes. This variety interferes with the defining of types and the calculation of characteristic values.

In a general way, manufacturing sites in cities of from 20,000 to 100,000 population are worth from $500 to $2,000 per acre,

without trackage, and from $1,000 to $25,000 per acre with trackage.

The larger the size of a city the more stable the price of any given class of manufacturing sites becomes, and the more easy it is, therefore, to borrow money on such real estate. The off-setting advantage of country location is that lower prices per square foot allow the works to be spread out so that the fire hazard is reduced, and a free use of one-story structures can be made.

The location of retail establishments. — The location of mercantile establishments in a city is primarily based upon the fact that the central point of a settled area (uneven topography aside) is the point most accessible to customers. If the existing retail center is not near this point, that is to say, if the city has been growing more rapidly in some directions than in others, the retail district will be found to be in a slow process of travel toward the centre of population, inferior stores, small repair shops, and abandoned buildings marking the off-side, while new specialty shops mark the approach toward the main residence district. Within the shopping district the universal providers, such as the department stores, and the better managed institutions which are able to utilize high densities of traffic to best advantage, will be found occupying the best central locations, while single-line shops of narrow appeal, and the less efficiently managed stores will occupy the side streets and the outskirts of the shopping district.

Within the shopping district a store will seek the neighborhood of stores of its kind, or stores which appeal to the same class of customers. The habit of the customer, when bent upon a particular errand, is first of all to place himself or herself in the quarter where there is the best combined assortment within a street frontage of a few hundred feet. The customer will then shop around from store to store, only going to outlying stores after the stocks of the chief group have been examined. Most shopping streets, especially in medium-sized and small cities, will be found to have one side devoted to women's

trade and occupied by dry goods stores, jewelry stores, furniture stores, and the like; while the opposite side of the street will have the hardware stores, saloons, and cheaper restaurants. There is a slight tendency for the woman's trading center to be on the south side of an east and west street, to secure the advantage of shade. There is also a slight tendency for this center to occupy the side of the main street which lies nearer to the best residence district. Mercantile values are injuriously affected by vacancies, buildings in course of construction, and by non-mercantile buildings, such as a church or court house. They are also injuriously affected by slopes which materially increase the effort of movement on foot or in vehicles.

When a city reaches such size that a couple of hundred families live at a distance of approximately a half mile from the chief shopping center, there is likely to be formed a neighborhood-convenience sub-centre, consisting of a grocery store, a meat shop, a saloon, and a drug store in which the sale of soda, cigars, and magazines and newspapers helps out the prescription trade. With the continuance of growth, such sub-centres tend to arrange themselves at half-mile intervals on the chief lines of radial travel.

Local inducements. — To return to the question of the location of manufacturing institutions, the usual forms of inducement offered by cities to new enterprises looking for a location are, free sites, subscriptions to stock, loans on easy terms, exemption from taxation for a period of years, and general assistance in learning the resources of the locality and in making business connections. The best opinion is strongly against tax exemptions or outright gifts in any form.

In some aggressive cities the boards of trade or chambers of commerce are experimenting with the policy of aiding new concerns by means of specially organized fostering corporations, which do not aim at private profit, but at the general upbuilding of the neighborhood. In one locality effort may take the form of a Loan Corporation organized by citizens with the object

of loaning funds to new enterprises approved by the local commercial association, sufficient interest being charged to pay expenses and even, perhaps, yield a small dividend. In another place the enterprise may be a Holding Company which will invest not over a given maximum sum in the bonds or stocks of an approved new concern. Still another form of fostering corporation is a Real Estate Development Company which stands ready to purchase a site and build structures for parties approved by the commercial association, either renting the properties or selling them on easy instalments.

Credit guarantee funds. — Several cities have been helping new concerns by means of a credit guarantee fund established by the subscriptions of citizens. Under this plan no money is called for. The subscriptions are simply guarantees. The subscribers appoint trustees or attorneys-in-fact to represent them, empowering these trustees to obligate them to the extent of their subscriptions. An applicant deals with an investigating committee of the local commercial association. If this committee reports favorably, it recommends to the trustees a definite loan of credit. Should the trustees approve, the borrower makes out his notes, receives the endorsement of the trustees upon them, and on this collateral secures a loan from a designated bank. Interest is charged, and the rate may even be fixed one or two per cent above the current rate to cover costs and provide a contingent fund. The period of the loans may range from five to ten years. In case the loans are paid, the subscribers to the fund are not called upon. But if there is default, the subscribers must pay pro rata according to the amount of their subscriptions. Subscriptions are for a definite period. Copies of the subscription, of the power of attorney, and of the essential contracts must be filed with each bank making loans. The plan is intended to aid only in the initial financing of young concerns. With various modifications of detail this idea has been used at Worcester, Mass., Williamsport, Pa., Jackson, Mich., and Peoria, Ill.

Mr. W. S. Milliner, Secretary-Manager of the Williamsport Board of Trade says, in a letter to me, that the guarantee plan was abandoned there in June 1914, after continuing for about fourteen years. The management of the fund was very conservative, the attorneys-in-fact taking mortgages upon some property of the borrower whenever endorsing notes. The losses were so small that they were, in each case, met by the directors of the Board of Trade and by prominent and wealthy citizens, so that a general assessment on the guarantors was never made. In practice, it was found that the credit of a borrowing concern was materially injured, so that it was difficult for that concern to secure further accommodations, except with the same kind of security. It is the judgment of those connected with the plan in Williamsport that the chief advantage resulting from it was the attention attracted to the city, and the inquiries brought from industries seeking a new location, rather than anything which resulted from the actual operation of the plan after the industries had been attracted. "It is doubtful," concludes Mr. Milliner, "if any plan of this sort, or any modification of it, will secure for a city industries which are really worth while, that could not be secured through established and liberal banking circles, together with the aid of public spirited citizens able to become investors in a worthy industry."

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CHAPTER IV

LAYOUT OF A MANUFACTURING PLANT

The problem. — The planning of an industrial works is much like the planning of a farm, or a garden, or a residence, or even a kitchen, — for a kitchen is a workshop. It has points of similarity with the planning of a city. In each of these cases there are certain functions to be provided with space requirements, which functions must sustain definite relations of area and direction with each other. The functions of an establishment, of course, vary greatly in individual significance. They vary also in the degree of handicap they will suffer from lack of adequate space and position. The problem of layout is to discover such an arrangement as will secure the greatest convenience for the most important functions. To state this a little more accurately, we may say that the optimum plan is the one in which a series of quantities representing the importance of the various functions, multiplied by quantities representing the advantage secured for those functions by space and location will amount to the greatest possible sum.

Layout and administration. — A proper plan conforms to economy by insuring complete utilization of buildings and grounds, and by facilitating the movement of material from process to process; but it avoids the parsimony of condensing things to such an extent as to produce a cluttered shop with its impeded movements and its perpetual rearrangements to make room. It is a great merit of a plan if it facilitates the judgment of the state of affairs in each shop by the mere observation of the locations of things. A confused advance of materials per-

mits soldiering, for it interferes with the individualization of work. It is a cardinal point of policy in "drive management" to secure straight-line sequences, so that an undue accumulation of material at any point can be taken as the sign of inadequate performance. A clear progression of work is essential in any management which aims at a definite time schedule, for it is only by the movement of definite quantities of work in definite periods of time that the capacity of individual production centres can be measured, and such capacity be held to specific performance.

The given factors. — The points which are most likely to be decided upon before serious work on the layout of a plant is begun are, that a given sum of money can be devoted to the enterprise, that a certain piece of land is to be used, and that a given output is to be provided for. From these determinations the number and size and character of the processes can be deduced, and a general estimate be made of the requirements in the way of men, machines, power, buildings, and ground area. The layout then involves the exact determination of the space relations of the various production centres. Its completed conception is of a huge mechanical leviathan or automaton of a certain length, breadth, and height. The last step in planning is to cover the whole with a shell of appropriate buildings.

The analysis of a production centre. — The determination of the layout of a works includes the location of the individual productive units within each shop or department, and the grouping of the departments to compose a complete plant. The first step is then the analysis of production centres. How does the space divide itself in a single centre, composed of a workman who stands in front of a section of wall bench, or composed of a machinist at his machine surrounded by aisle spaces and piles of materials? What space is necessary on the four sides of a certain type of machine, to permit access for adjustment? What aisle width is necessary between ma-

chine rows? What should be the width of main aisles? What floor area is needed to pile a given amount of certain materials? What is the proper width for work benches? It will facilitate matters to make a number of standard space determinations for such elements as occur again and again. The total space requirement of any production centre can then be arrived at by allowing for all the standards involved in it, and adding space for any special requirements. In this way analysis of areas may proceed from one process to another, covering in the end not only the requirements of manufacturing departments, but of the warehouses, offices, and yards.

Sequences. — A different problem of layout is to determine the relations of production centres with reference to the sequence of processes and the movement of materials from step to step in manufacture. Some industries comprise a single simple chain of performances which may be represented thus:

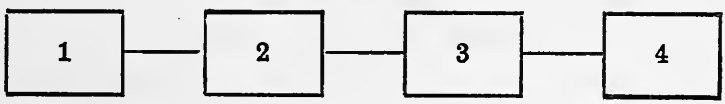

Fig. 3. Simple Sequence

The material moves straight on, as in a paper mill, from one process to another, until the end is reached. Other industries involve a number of separate sequences which move along in parallel series.

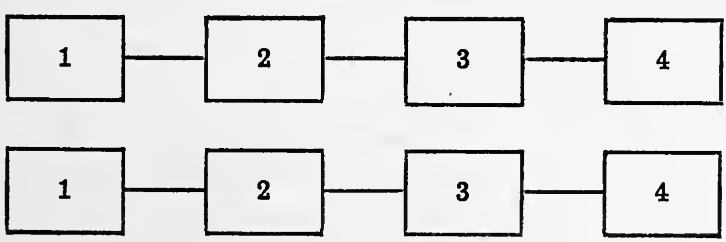

Fig. 4. Parallel Sequence

Still other industries, such for example as slaughtering and meat packing, consist of the repeated subdivision and elabora-

tion of a complex raw material, until it is differentiated into a large number of separate commercial products.

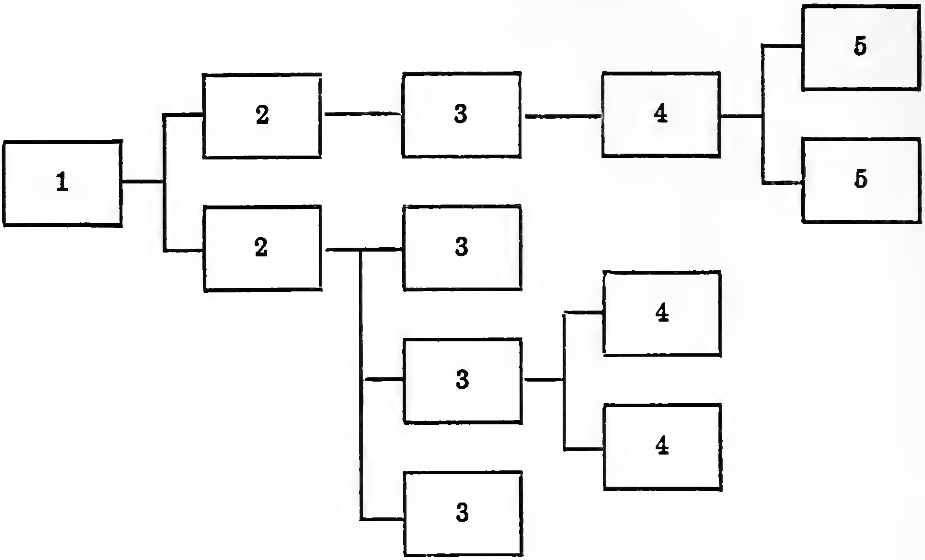

Fig. 5. Elaborative Sequence

One of the commonest manufacturing processes involves the manufacture of parts which may individually run through longer or shorter series of simple sequences, to be then grouped into minor assemblies, which in a final synthesis take their places in a complex completed product.

The simpler the sequences the straighter can be the line of forward movement, and the freer it can be from détours and reverses and complex doublings. Straight-line movements have the advantage of speed, minimum trucking expense, compact layout, close supervision, minimum of noise and dust, and minimum distraction of attention from work by journeyings to and fro.

Coördination. — In order that all parts of an establishment may be kept full of work and under even pressure (a condition essential to the development of a uniform habit of the shop), it is necessary that each class of production centre should coördinate in capacity with those centres which precede it or follow it, and which must therefore either supply it with work or take

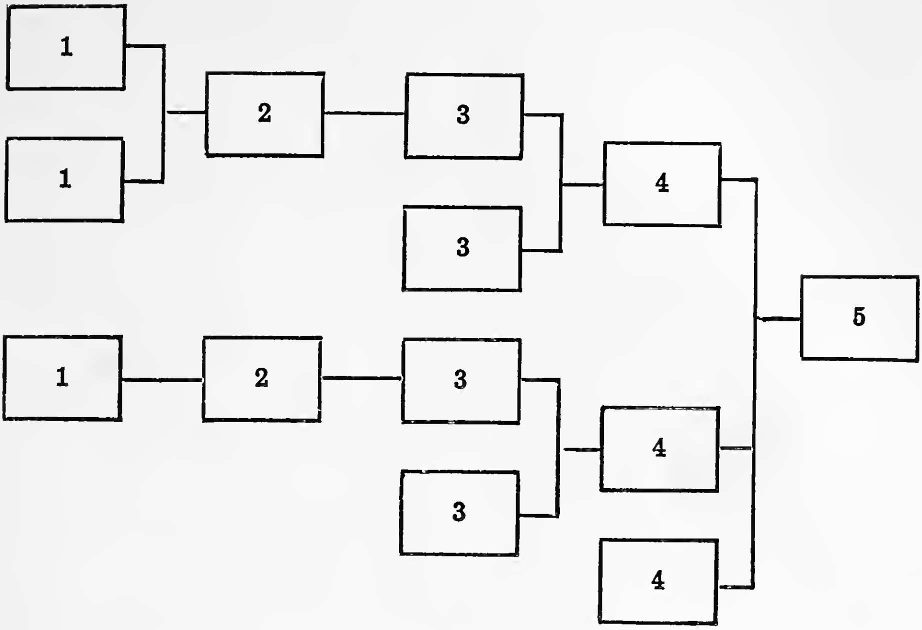

Fig. 6. Assembly Sequence

work from it. If we imagine a manufacturing process consisting of three stages, designated as A, B, C, and diagramatically represented as follows:

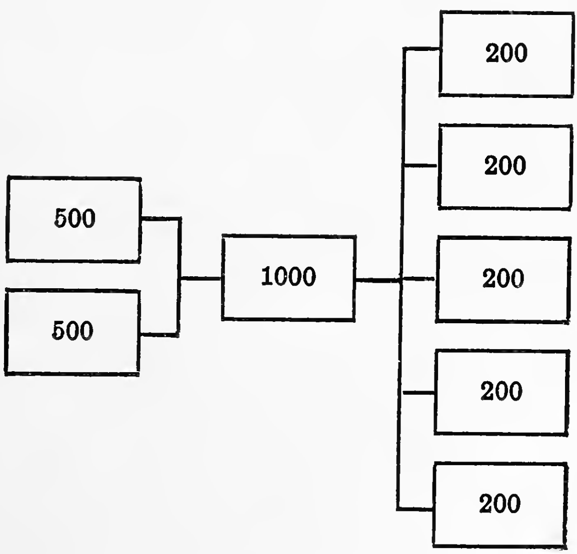

Fig. 7. Diagram of Coördination

it will be obvious that two machines of 500 capacity for *A* will fully employ a machine of 1,000 capacity for *B*, and five machines of 200 capacity for *C*. If we install a *B* machine of 1,300, in the best adjustment possible we shall either lose 200 on *A* equipment and 100 on the *C*, or else lose the 300 extra capacity in the new *B* machine. If a *B* machine of 1,400 capacity be installed, we shall lose 100 on *A*, in the best possible adjustment. Not until we equip all the processes for 2,000 can we again obtain as good a correlation as was had at 1,000. A rule of perfect coördination is that the total capacity of a series of connected manufacturing departments should be some common multiple of the capacities of the individual production centres composing those departments.

Transportation. — In internal transportation the complete journey is from tool point to tool point. The ideal in handling-economics is to have the final position of a piece of work, at the conclusion of an operation, serve as the initial position for the next operation. As such a condition is rarely attainable, the general ideal should be to reduce journeys between tools, as far as possible, to three parts: (*a*), a single short detail handling from tool to container, (*b*), a transfer trip of a quantity of products from the receiving position to the delivery position, in an easily propelled container, (*c*), a short detail handling from the container to the next tool. The costly elements in these journeys are the handlings, and especially the vertical ones. When the trunk of a workman's body must be bent for each piece, the efficiency of the energy expended is probably a small decimal. The aim should be to keep all handlings as short as possible, and keep them in the same vertical plane. A few vertical planes should be established for work throughout a shop; and change from one plane to another should be made in large lots by means of appropriate mechanical apparatus, such as elevating trucks or tiering machines.

The shop unit. — On the basis of the known space requirements of production centres, and the sequence of processes, and taking

into due account the laws of coördination and transportation, a process-area-diagram can be constructed. But before the centres are grouped into shops, it is necessary to ascertain the requirements of each process as to light, shafting connections, headroom, crane service, special foundations, and the relations which are to be sustained with every type of administrative and service department, so that in the final adjustment these needs will receive consideration. It is also necessary, in laying out the plans for a shop, to allow space for the foreman's office, for stairways and beltways, and intermediate storage spaces and toilet rooms.

Arrangement according to sequence versus arrangement according to type of work. — A problem arises, in organizing a series of shops, as to the proper location for work of a given kind, which occurs again and again at different stages in the process of manufacture. Should such work be done at the various points where it occurs in the regular line of advance, with the necessity, perhaps, of installing the same kind of machine in two or three shops? Or should all work of a kind be done in one place, even though it be necessary to shift materials back and forth? If the first plan is followed, as is the tendency in mass production — the dominant thing will be a straightforward progression. If the second plan is followed, — as usually happens in specialty manufacturing — the controlling motive will be to secure the advantage of massing all of one kind of machinery, labor skill, and administrative experience in one place. The usual solution of this problem is a compromise, which may be defined briefly as straight-line movement of materials when they are handled in quantity, while at the same time expensive units of equipment are kept in operation as steadily as possible.

Arrangement of shops to compose a plant. — The elements of which manufacturing establishments are composed may be listed as, 1, Raw-material storage and finished-product storage. 2, Intermediate storage. 3, Manufacturing centers. 4, Assem-

bling rooms and erecting floors. 5, Tool rooms. 6, Stairways, beltways, elevators, and halls. 7, Toilets, lockers, and rest rooms. 8, Drafting room. 9, Planning room. 10, General offices. 11, Power plant. 12, Yard departments.

Service centres. — It is profitable to group certain of the service departments, the sanitary accommodations, and the spaces reserved for transportation and communication, in the form of narrow bands between the shops, and enclosed between fire-

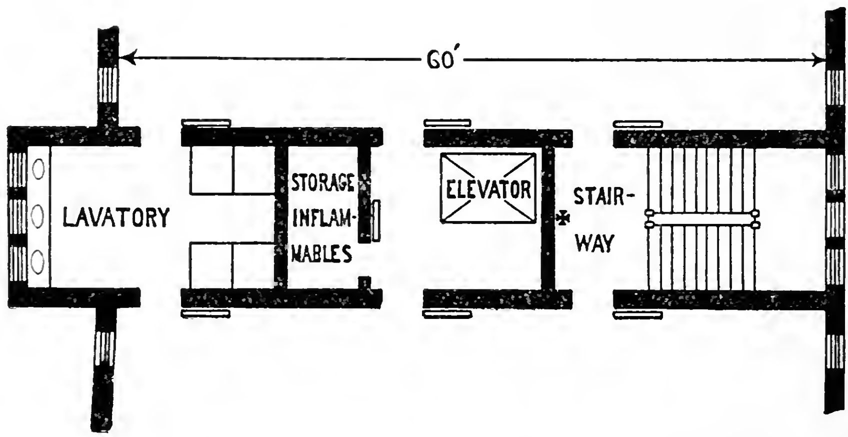

Fig. 8. Plan showing the grouping of service centers between fire-proof walls, separating two shops. All doorways protected by self-closing, fire-proof doors. ✠ = fire plug.

proof walls. By this arrangement the shop areas are broken up as little as possible, building space is economized, lighting is improved, and the hazard of fire is decreased. An illustration of such a grouping is Figure 8.

A similar plan, including beltways, is recommended by the Boston Manufacturers' Mutual Fire Insurance Company. See Figure 9.

Segregation. — Since a group of associated departments will suffer from noise according to the noisiest one, and will take the insurance rate of the most hazardous one, there is economy in sorting out departments so that birds of a feather will flock together. There will be some incidental segregation if a plant

is so arranged that the receipt of raw material, together with the power plant, and the heavy manufacturing processes — usually the preliminary ones — are grouped around the receiving switch; while at the other end of the main axis of the grounds, to the windward, and near the shipping switch, are located the finishing processes, the finished stores, and the general offices. Prudence will, of course, suggest the emphatic segregation of dangerous elements, such as gasoline storage and high-tension transformers, and of noisy and dusty processes like those of the foundry and forge.

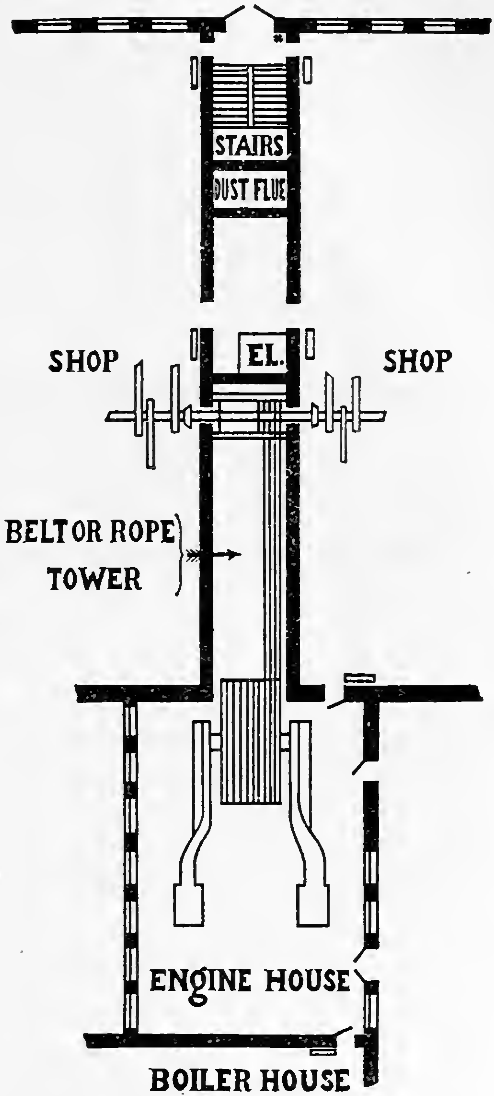

Fig. 9. An arrangement of beltway, elevator, and stairway recommended by the Boston Manufacturers' Mutual Fire Insurance Co.

Yard departments.— A factory yard should be looked upon as a group of unroofed departments, together with spaces reserved for future growth. Generous room for storage permits buying in large lots. It facilitates mechanical handling, by allowing storage spaces to be laid out as a series of parallelograms, within reach of track cranes. And it reduces to a minimum the handling which is incident to rearrangement.

In laying out standard railway tracks a minimum radius for short arcs is 100 feet, for longer arcs 150 to 200 feet. It is desirable to arrange easy curves, to separate receiving from shipping switches, and to tie the crane service and the industrial railway service together by judicious interlacing. But it is wise, also, to avoid running railway tracks through buildings; and to avoid arranging the walks and roads which must be followed by workmen in such a manner that tracks must be crossed near doorways or near the corners of buildings.

Enlargement. — It is always a nice question to what extent present economy should be sacrificed in order to build on a plan which will permit of economical future enlargements. And it is also an uncertain matter in what proportion space for enlargement should be distributed between the various departments. Questions concerning enlargement are the more easy of answer in the measure that an establishment is built upon cheap ground, or that it is large in size to begin with, or that it has to do with a branch of industry little subject to revolutionary changes in method. Again, enlargement is simple when growth means the duplication of certain distinct units rather than a fundamental reorganization of the entire plant.

Preservation of market values. — If a plant is constructed in a large city, where the sale of manufacturing buildings is possible, and where the shifting of population causes frequent changes in the functions of localities, consideration should be given to the preservation of the real estate values or sale values by building structures which can be adapted to a variety of uses with a minimum of remodeling. What this implies in the way of design may be ascertained by the study of the loft buildings now being constructed for leasing purposes in large cities. As country or suburban plants are usually salable or rentable only at a great sacrifice, it is probably wise to give them the most perfect possible adaptation to the primary purpose, and stake everything on the original venture.

Ground plans. — The I plan: The simplest type of manufacturing plant is a single building of a width consistent with

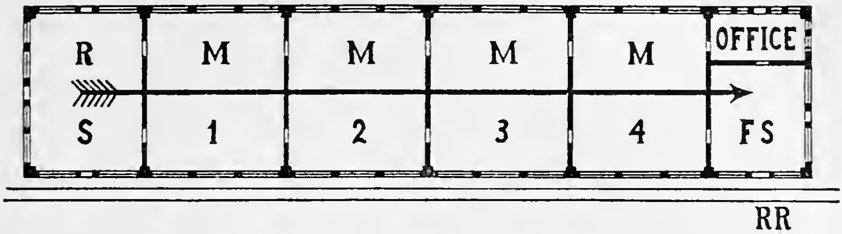

Fig. 10. I Plan

R. S. = Raw material stores.
F. S. = Finished stock.
M 1, 2, 3, 4 = Manufacturing departments in order of sequence.
R. R. = Railroad siding.

efficient lighting, and of a length depending upon the floor space to be provided. Such a plan may be illustrated, in abstract form, by Figure 10.

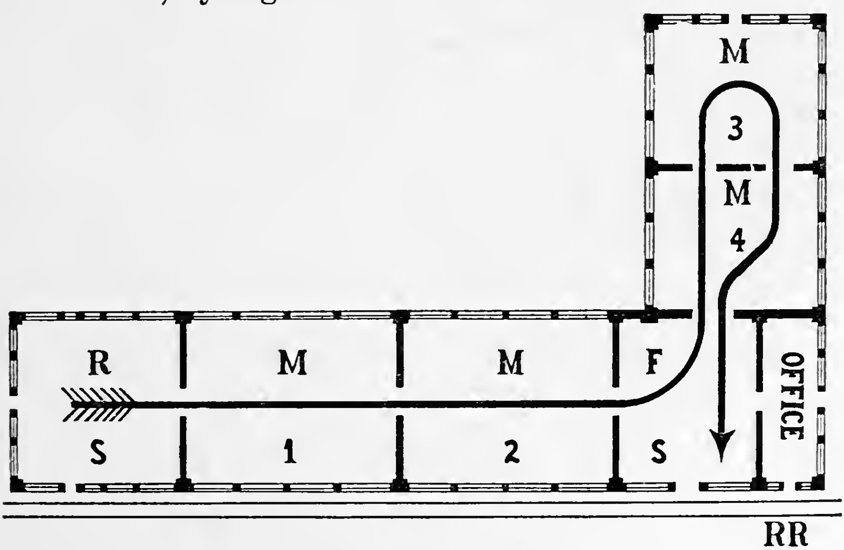

Fig. 11. L Plan

L and U plans. — The enlargement of an I plan is likely, at first, to produce some sort of an L or U plan, from the necessity of turning to avoid property limits.

Accretionary plans. — Further enlargements are then apt to give evidence of the breakdown of the plan, and to produce

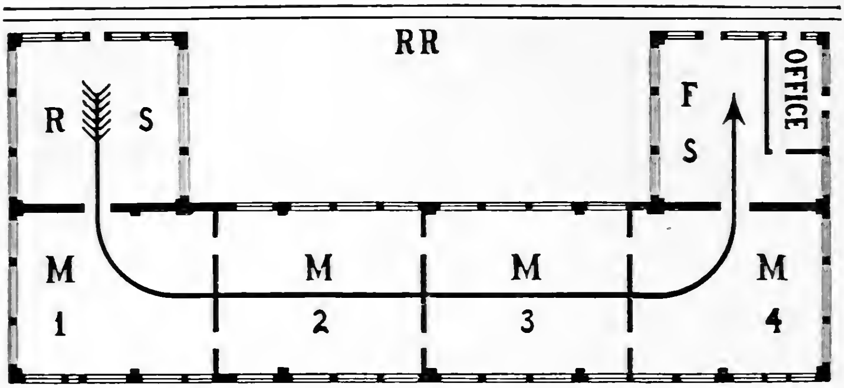

Fig. 12. U Plan

the confusion of an accretionary factory type. Continued enlargements rapidly lower the efficiency of such a plan; while radical enlargements mean a clean sweep.

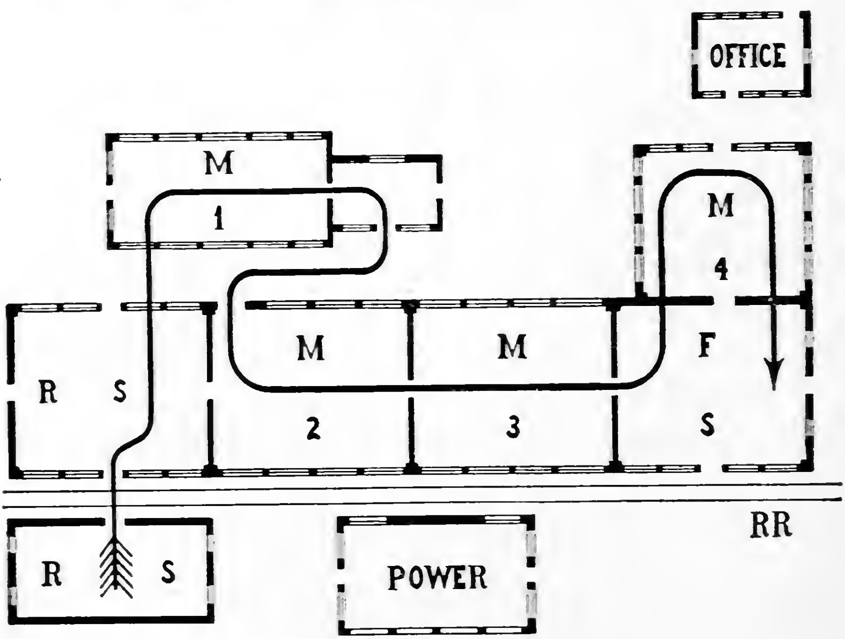

Fig. 13. Accretionary Plan

Duplicate I plans. — An I plan may, of course, consist of several buildings.

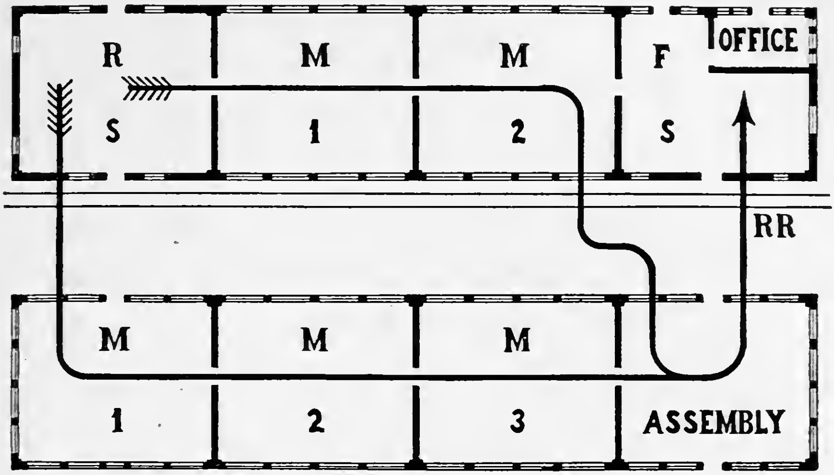

Fig. 14. Duplicate I Plan

Quadrilaterals. — The enlargement of a duplicate I plan may produce a quadrilateral, when connecting structures are thrown across between the original buildings.

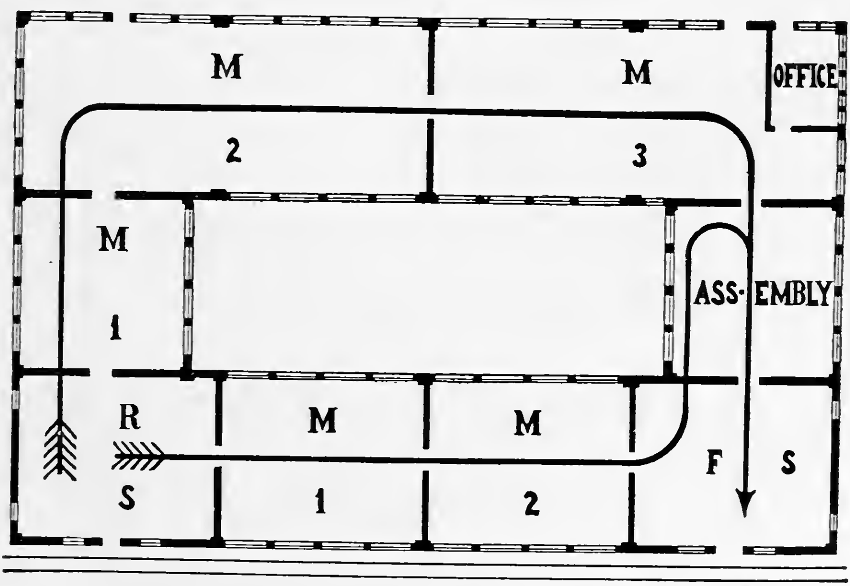

Fig. 15. Quadrilateral Plan RR

This plan was in favor in this country, for a few years, in the seventies and eighties. It was even made the object of original construction, because of indoor communication, and in spite of the obvious disadvantages in the way of inaccessible courts, a bad fire risk, and varying light. A modification of this idea, standing part way between the duplicate I and the quadrilateral plans, but without some of the disadvantages of the latter, is to employ a series of parallel main buildings, and to connect them with passageways devoted to service departments. The plant of the United Shoe Machinery Company at Beverly, Massachusetts, has the following general ground plan:

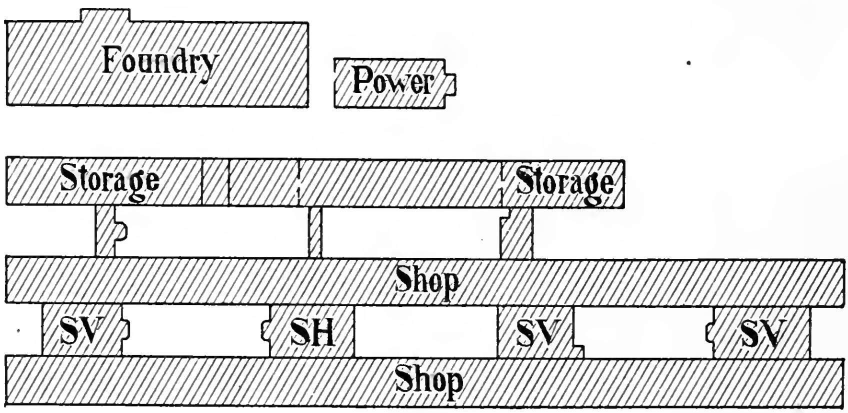

Fig. 16.

Ground plan of the factory of the United Shoe Machinery Co., of Beverly, Mass., showing service centers.[1] S = Service center including locker room, wash room, tool storage and delivery room, stairway, and connecting passage between buildings. V = Ventilating fans. H = Emergency and first aid hospital.

Enlargements as lateral extensions. — To provide a plan which will be from the start reasonably compact, but will permit of the independent enlargement of any of its parts without destruction of the original scheme, it is necessary to house the departments in separate buildings, and to provide that the

[1] L. P. Alford and H. C. Farrell, Factory Construction and Arrangement, Journ. of Am. Soc. of Mech. Eng., Oct. 1911, Vol. 33, No. 10, p. 1144.

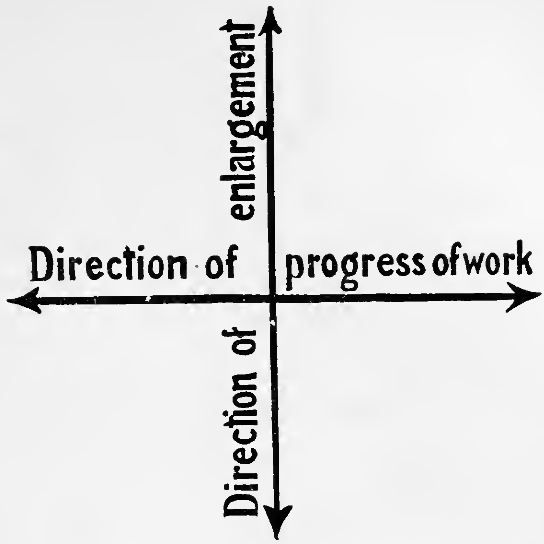

Fig. 17. The Principle of Easy Enlargement

main direction of the progress of work shall lie at right angles to the direction of enlargement. This simple but exceedingly important idea may be graphically expressed as in Figure 17.

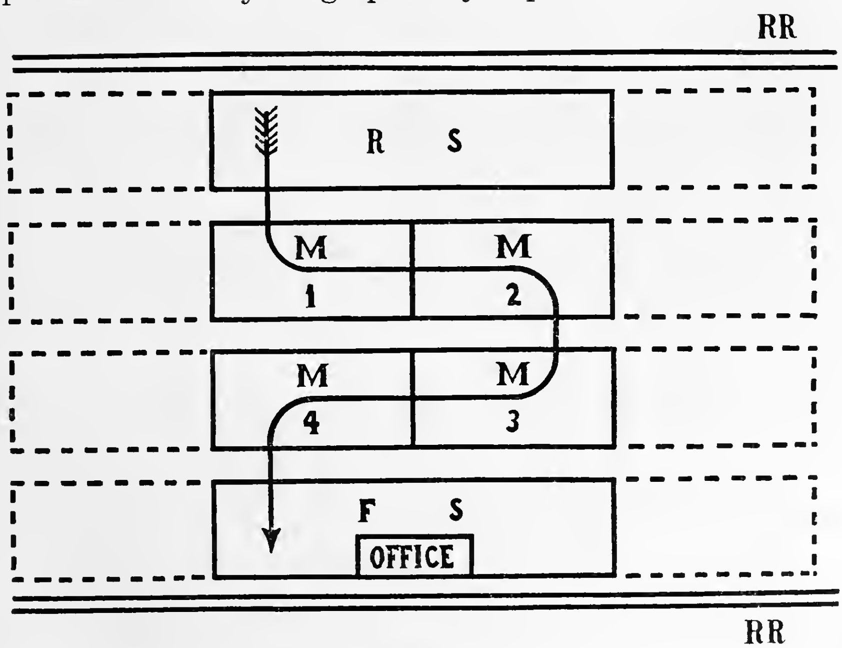

Fig. 18. The Enlargement of a Unit I Plan

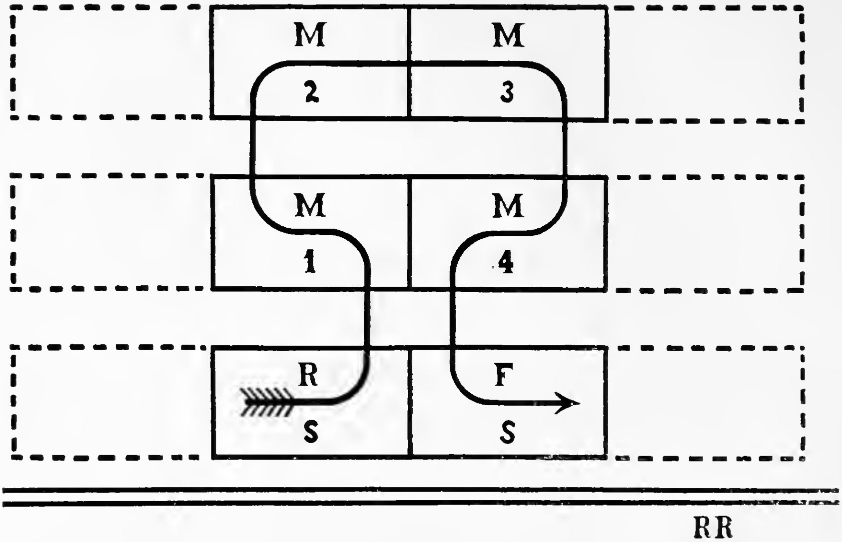

Fig. 19. The Enlargement of a Unit U Plan

Enlargement of unit I and unit U plans. — The above-mentioned law of planning may be worked out in I and U plans, as

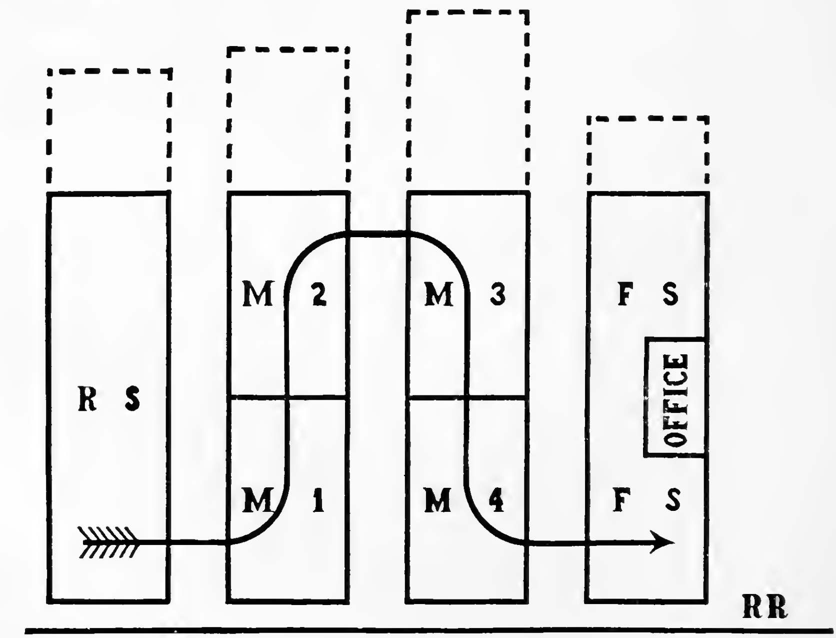

Fig. 20. Arrangement Permitting the Partial Enlargement of a Unit I Plan

shown in diagrams 18, 19, and 20. In diagrams 18 and 19, enough separate buildings are provided so that each department either has an entire building, or an end of a building to itself, and has a direction free for enlargement without shifting

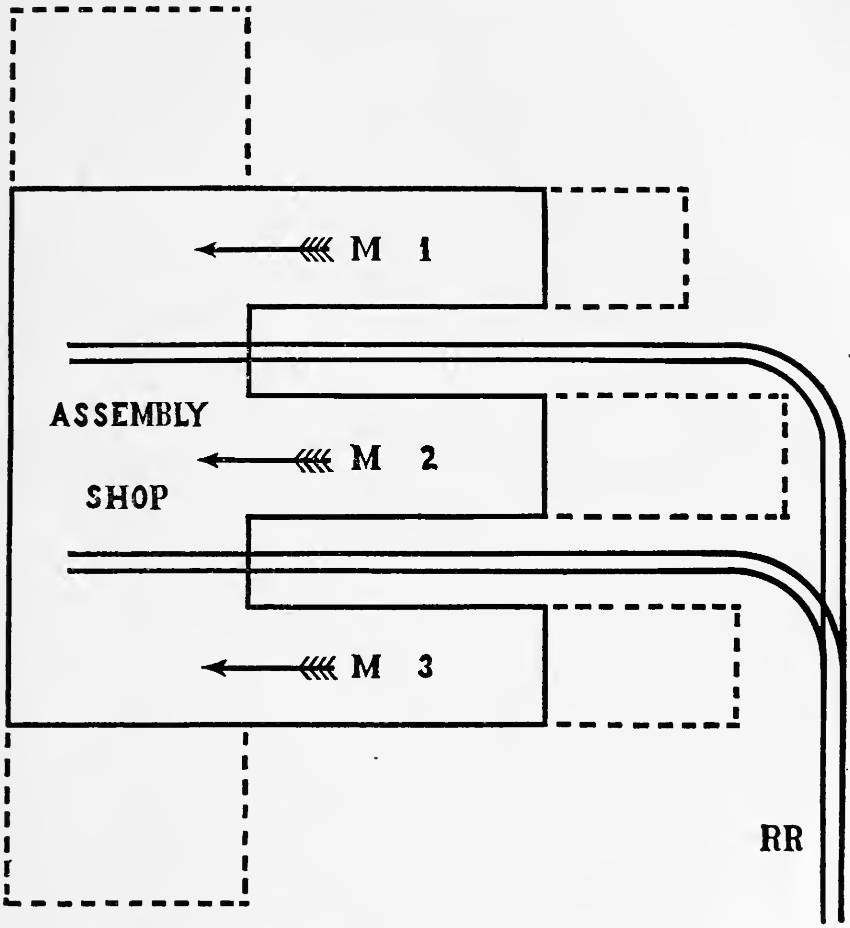

Fig. 21. The Enlargement of an Assembly Shop and Subsidiary Departments

railroad sidings. The housing of departments in separate buildings gives rise to what is called a unit plan. In such plans each department can be enlarged by carrying the building along, while yet the proximity of any department to the other depart-

ments which lie along-side of it in parallel buildings is not disturbed.

In Figure 20 a complete enlargement would require the moving of the railroad siding, or the rearrangement of partition walls.

Enlargement of assembly shops. — The assembly type of manufacturing structure can be arranged to permit of the independent expansion of parts in the manner shown in Figure 21.

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CHAPTER V

BUILDINGS AND EQUIPMENTS

Functions. — The principal functions which manufacturing buildings perform are to control the conditions with reference to heat, light, humidity, and air circulation, ensuring the comfort and health of workmen; and to protect mechanical equipment and materials in process of manufacture from injury by the weather. Buildings provide foundations for machines, and a rigid framework for the transmission of power. They subdivide and regulate fire risks, isolate noisy and dusty departments, multiply floor area by means of upper stories, and provide "A local habitation and a name" for each of the shops and administrative units.

The general executive and the technical expert. — The preparation of a set of plans and specifications for a manufacturing plant is a task which requires the working together of technical knowledge and general administrative power. It, therefore, raises the problem of the way in which general administrative officers shall adjust themselves to specialists. It is easy to say that each should decide those matters for which he is best prepared by formal training or experience. The difficulty lies in the application of the rule, for in the degree that men specialize they become ignorant of each others' training and special province of action.

The general administrator must, of course, supply the given factors, informing the architect as to what line of manufacture is intended, what funds are available, and what site is owned or considered. But even upon such fundamental matters there

may be a profitable response from the expert's special knowledge. A mill architect may be able to point out a by-product industry which should be coupled with the main project. Regarding financial limits, he can call attention to those economies which are costly and those additional expenditures which will bring more than proportional returns. He will consider a proposed site, not so much from the point of view of its price, as with reference to footings, drainage, and the effect of size, outline, and contour upon the general layout.

As the calculations proceed from general matters to such details as live and dead loads, girder spans, location of pillars, design of roof trusses, intervals between wall pilasters, arrangement of windows, location of beltways and lines of shafting, the type of ventilating system to be used, the location of lighting units, et cetera, the administrator will be confined more and more to such general supervision as has for its object to see that his firm secures the service it is entitled to expect, considering the fees paid and the scientific maturity of the profession involved. When a general administrator supervises work in a field with which he is not familiar, he must resort to general tests of capacity, such as the steadiness or uniformity of the expert's opinion on any given matter, the clearness of his ideas as evidenced, for example, by ability to express the gist of technical discussions in simple language, expertness in details as shown by speed and precision in handling, the soundness of such ideas as the expert may express on subjects of which the administrator happens to be a competent judge, and unwillingness to work with methods or under conditions which would endanger success.

In the choice of machinery and equipment, where engineering theory must be supplemented by operative experience, and consequently there are two aspects of a matter to be kept concurrently in mind, the consulting expert and the practical executive must tactfully feel their way into an intimate coöperation as working partners, finding each other's points of strength and

weakness, and supplementing each other in good faith. If conceit, suspicion, or intolerance mark the attitude of either party this delicate adjustment will be impossible. If the general administrator possesses superior knowledge of local conditions, he should consider the applicability of the rates of interest, of wages, of taxes, and of insurance used in the computations of the expert, as well as the reasonableness of the scrap values assumed.

The object of the discussions of this chapter, and of the one following it, is to facilitate the approach of the general administrator to the field of the technical expert; it is not to encourage his encroachment into that field.

Unit stresses. — The unit stresses to which the various floors will be subjected will determine the thickness of the walls, the cross sections of the girders and pillars, and the style of construction. A well prepared layout, showing the nature and location of equipment, the delicacy of the alignment required for the machines to be used on the various floors, and the weight of materials to be carried, will assist the engineer to make proper provisions, while yet localizing expensive forms of construction.

First floor and basement. — The height of the first floor is usually determined either at the ground level, or at the height of the floor of a railway car, or at a height sufficient to permit of a basement. If the site is reasonably level, it is desirable to have like floors of all buildings at exactly the same elevation above the sea level, so that, in case connecting structures are built in the future, the use of stairs or incline planes may be avoided.

If the first floor is to be several feet above the ground, a basement can be added at very little extra expense. As Mr. Geo. M. Brill has said, "To provide against frost it is necessary to carry foundation walls from three to five feet below the surface of the ground. This depth, with the distance up to the first floor added, gives nearly the requisite height for the basement.

Therefore, such space can generally be obtained for the expense of removing the soil and increasing the depth of the foundations."[1] Such basements are convenient for storage and for placing wiring, shafting, and heating pipes. On basement floors the heaviest machinery can be provided with adequate foundations.

Widths and heights. — The width of a building and the height of its ceilings are dimensions which must be determined with reference to each other. Unless there is roof lighting, the greater the width of a building, the higher the windows must be to give adequate illumination in the centre of the rooms. Let us assume, for illustration, that it is decided to build a structure which, in each story, will provide an inside shop, bounded by two opposite outside walls and two partition walls; and that it is desired to secure in these shops a lighting standard expressed by the ratio of one square foot of window area to each five square feet of floor space. Let us further assume that on the average 75 per cent of the space of each running foot of outside wall can be devoted to windows. If we set a ceiling height of 11 feet, the window area per running foot of wall will be 8.25 feet. This figure multiplied by 5 gives 41.25 feet as the maximum allowable distance from the wall to the middle line of the floor. Calculating in the same manner for the opposite wall, there is indicated a total building width of 82.5 feet, inside measure. Under like conditions a 10 foot ceiling would indicate a 75 foot building width, and a 12 foot ceiling a 90 foot width. In the older styles of factory construction which permitted only 50 to 60 per cent of the wall space to be in windows, a width of 60 feet was considered about right for 11 foot ceilings. In modern construction, which allows 75 per cent of the walls to be in windows, such a ceiling height would light a building 75 feet wide equally well. Exact adjustments with reference to lighting must, of course, take into account the interruptions

[1] Location, Arrangement, and Construction of Manufacturing Plants, Journ. Western Soc. of Engineers, Apr. 1908, Vol. 13, No. 2, p. 158.

of pillars and belting, and the enhanced illumination possible with smooth ceilings, white paint, and prism glass.

Length. — In determining the length of a manufacturing building, the fire hazard exerts an important influence. Assuming that the width has been determined by lighting considerations, the length of a floor must not exceed such a dimension as multiplied by the width will give a total floor area within the maximum allowed by municipal building ordinances and the rules of fire underwriters' associations. The Chicago building ordinances fix the maximum floor area within fire walls at 9,000 square feet for ordinary construction, 12,000 square feet for slow-burning construction, and 30,000 square feet for fire-proof buildings. Using our previous illustration of a building 82.5 feet wide, this ordinance would give lengths of 109, 145, and 364 feet, respectively, at which points, according to the style of construction, it would be necessary either to end the building or divide it by a fire-proof partition wall.

Another consideration determining length is the cost per square foot of floor area. The rapidity with which cost falls with increase of length differs according to the width, the number of stories, and the style of construction employed. The decrease of unit costs with the increase of any dimension is not a uniform thing but is roughly in inverse proportion to the size of the dimension which is made the basis of calculation. The rule of decrease of unit costs is simply a special case of the general principle of economy of production on a large scale, so that if the general specifications already make a job large in size, little reduction in cost can be expected from the further increase of some particular dimension. When, therefore, the width of a proposed structure is large, or there are to be many stories, or the style of construction is expensive, an increase in length will exert slight influence in reducing unit costs. It may be stated in a general way that, for construction types of average expense, the increase of the length of a structure from 50 to 100 feet will decrease the floor square-foot cost from one-fifth

to one-sixth. An increase from 100 to 150 feet will decrease cost by less than one-tenth. There is little economy in increasing length beyond 200 feet.

Number of stories. — The first thought with reference to the proper number of stories is the convenience of keeping several processes within one building, but distinct from each other. In cotton spinning a three-story arrangement is often used; one floor being used for carding, another for mule spinning of filling, and a third for the ring spinning of warp. The United Shoe Machinery Company of Beverly, Mass., decided upon four-story buildings, because their service departments require as much space as the making departments. In their buildings the basements are used for storage, the first and second floors for the manufacturing departments, and the fourth floors for tool manufacture and experimental work.

The lowest cost per square foot of floor space is achieved by three and four-story structures. The reduction of cost above two stories is not considerable however. With the addition of stories above the fourth, the square-foot cost increases rapidly, because of the necessity for better foundations, thicker walls, and more ample allowances for stairways, elevators, and fire escapes. Into the problem of fixing the number of stories enter such factors as the value of the land, the economy of heating buildings when the dimensions are approximately equal and the stiffness required in the structure to keep machinery in adjustment.

One-story buildings. — With the exodus of manufacturing establishments from large cities in recent years, and the choice of locations in village and country neighborhoods, one-story buildings have come into frequent use. Mr. M. S. Ketchum says in behalf of them, "The best modern practice inclines toward single floor shops, with as few dividing walls and partitions as possible. The advantages of this type over multiple-story buildings are, (1) the light is better, (2) ventilation is better, (3) buildings are more easily heated, (4) foundations

for machinery are cheaper, (5) machinery being set directly on the ground causes no vibrations in the building, (6) floors are cheaper, (7) workmen are more directly under the eye of the superintendent, (8) materials are more easily and cheaply handled, (9) buildings admit of indefinite extension in any direction, (10) the cost of construction is less, and (11) there is less danger from damage due to fire."[1] Where clear floor spaces of twenty-five feet or over are required, multi-storied structures are undesirable, because of the expense of supporting upper floors on long girders.

Types of construction. — Factory buildings may be divided into four classes, according to the materials employed in construction. "Ordinary frame" buildings are entirely of wood. "Slow-burning" mills are composed of brick walls and heavy wood framing. Steel frame structures may have curtain walls of brick and floors of wood, with exposed frame, or the steel may be fire-proofed with terra cotta or concrete. Reënforced concrete buildings consist of a framework of massive posts and deep slabs in which buried wires or rods serve as tension members. The floors are usually of concrete and the curtain walls of brick.

Ordinary frame. — The "ordinary frame" factory is a form of combustible architecture appropriate only for one or two-story structures, large grounds, small capital, and temporary plans. It is constructed by the use of numerous thin joist and rafters, supported by inside posts and light wall studs, the frame being thinly sheathed and roofed to keep out the weather. It is full of sharp edges of wood along which fire runs rapidly, and of spaces in which dirt can accumulate and fire make a protected advance. The stairways are usually built of light inflammable material and, in case of fire, carry the flames from floor to floor, cut off escape from the upper floors, and provide vertical shafts to improve the draft.

[1] The Design of Steel Mill Buildings and Calculation of Stresses in Framed Structures, N. Y., 1903, p. 142.

Slow-burning construction. — "Slow-burning or standard mill" construction employs timber in massive sizes. It rejects all framing sticks any dimension of which is less than six inches; and it substitutes two to three inch roof plank and three to four inch floor plank for the thin boards used in ordinary frame buildings. The reason for this generous use of wood is that the charring action of ordinary fires seldom penetrates a solid stick more than half an inch. When all the wood supports and fire stops

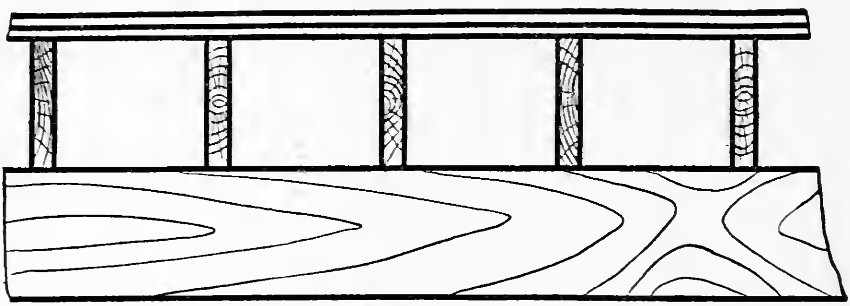

Fig. 22. Undesirable Floor Construction[1]

The timber surface exposed in a ceiling area 8 by 8 feet in dimension is approximately 26,000 square inches.

are able to bear this deduction from their dimensions, without bringing down the building, a reasonable opportunity is given for putting a fire under control. The difference between good and bad floor construction is illustrated by Figures 22 and 23.

A second principle of slow-burning construction is that each floor shall be a closed fire unit. To accomplish this the floors must extend unpierced from wall to wall, and all elevator ways and stairways must be enclosed in walls as incombustible as the floors themselves. All openings in inside walls should be equipped with self-closing fire-proof doors.

A third principle is that the ceilings over all specially hazard-

[1] Insurance Engineering Experiment Station, Report No. V, Slow-burning or Mill Construction, Boston, 1908.

ous stock or processes shall be protected with fire-retardant materials such as asbestos board, sheet metal, or plaster on metal lath. Standard mill construction will average, perhaps, one-fourth more expensive than an ordinary frame.

Steel frame buildings. — The chief structural members of steel buildings comprise a system of posts braced together at the junctures of floors and walls by horizontal girts, and carrying a series of braced roof trusses. Roofing materials are affixed

Fig. 23. Desirable Floor Construction[1]

The timber surface exposed in a ceiling area 8 by 8 feet in dimension is approximately 14,500 square inches.

by means of light purlins connecting the trusses. The walls are light curtains of brick, tile, or sheet metal, filling the rectangular spaces between the posts and girts. With wood floors and roofs, such structures are easily destroyed by fire, as a consequence of the buckling of the exposed steel. With concrete or terra cotta floors, and fire proofing for the steel, such structures are admirable but expensive. This form of construction has the advantage of being thoroughly understood and reliable in its engineering aspects, and of economizing space on the lower floors of many-storied buildings. The steel frame can be made to serve not only the function of carrying the building, but of supporting traveling cranes and wall machines and shafting and counter-shafting.

[1] Insurance Engineering Experiment Station, Report No. V, Slow-burning or Mill Construction, Boston. 1908.

Reënforced concrete. — Factories built of reënforced concrete are slightly more expensive than slow-burning structures, but are materially cheaper than those of fire-proofed steel. The advantages of concrete structures are that the floors are rigid and free from vibration, the sanitary aspects are unexcelled, maintenance charges are low, and fire hazard is reduced to the minimum. The drawbacks are that the safety of the structure is vitally dependent upon correct proportioning, a yet somewhat new field of design; and upon the mixing and pouring of materials, a process which requires close supervision. The rearrangement of shafting and machinery is difficult in concrete buildings, unless provision is made during construction for numerous points of attachment for hangers and floor bolts.

Fire Hazard

Significance. — The average fire loss of the United States, during the five years 1910–1914 inclusive, was $212,529,935 per year; a sum which amounted to $582,000 per day, $24,000 per hour, or approximately $400 per minute. Our annual losses may be pictured in the form of a street extending from Chicago to Denver, or from Chicago to New York City, lined closely on both sides with buildings, and being steadily licked up by fire at the rate of about three miles a day. At every thousand feet on this street there occurs a building from which an injured person has been rescued; at every three-quarters of a mile there is the scene of a horrible death. Some of the reasons why this country sustains losses enormously larger than most other civilized countries may be indicated in an indirect way by recounting the history of a fire in Berlin, Germany, as reported by the National Fire Underwriters' Association. "An American gentleman, temporarily living in Berlin, was awakened by smoke, and found that a fire originating in a room over him was eating its way through the ceiling of his dining-room. The blaze was extinguished with chemical apparatus without any water damage and without needless destruction of walls and

furniture. A careful investigation was made by officials and the next morning the man who turned in the alarm was sent for and taken before a fire marshal with inquisitorial powers. The examination of all involved showed that the fire started with a hot coal which had dropped from a laundry stove in the attic and rolled upon an unprotected wooden floor. The tenant proved that the stove was an appointment of the building, provided by the landlord, and that it was neither his duty nor his privilege to change it. The landlord proved that he had recently purchased the building under the usual guarantee that all laws and ordinances had been complied with in construction and appointment, that this stove had not been changed, and that his attention had not been called to any condition involving a fire risk. The builder from whom the owner purchased was then called and had to admit that he was responsible for the setting of the stove as the police had found it, and that he had violated the law in neglecting to provide a suitable metallic hearth of the required kind and dimensions between it and the floor. This responsibility was brought home to him by the assessment against him of the damage to the furniture and property of the tenants, together with the estimated cost to the city of responding to the alarm and extinguishing the fire, rounded out by an exemplary fine of 500 marks as a reminder that German laws are intended to be observed. The builder was not required to pay for the damage to the building, it being held that while the owner had not committed the violation of law which caused the fire, he had been neglectful in not discovering and correcting it, and for that reason should pay for his own repairs. He was informed that only the fact that he had owned the building for a short time saved him from a fine in addition." Such laws and such enforcement help to explain the fact that the usual per capita fire loss in Berlin is $0.30 annually, while the loss in Chicago is between $2.50 and $3.00.

Safe construction. — The man who causes a building to be constructed assumes a serious social responsibility as the maker

of a public record. He turns his mind inside out before the community. A miserable fire trap is a daily public demonstration to the neighborhood of the character and purposes of the owner. Good practice in construction may be summarized in a series of points, those matters being omitted which have already been presented.

1. Employ a competent architect.

2. Provide more than one fire unit for all floors above the second, by constructing at least one fire-proof partition wall. The experience of factory fires shows that, where a hundred or more persons are employed on an upper floor, stairways and fire escapes, even of generous proportions, are highly dangerous. If a panic develops, and a few fallen persons cause a blockade, the loss of life may be very great. When, however, a fire-proof partition makes it possible for persons to pass from one room to another on the same floor, the feeling of confidence that there is ample time to escape will preserve discipline, and an orderly exit will be possible. Even if a building is fire proof, this subdivision of floors will give protection to life in this manner, as well as serve to subdivide the risk on contents.

3. Floors should have as few openings as possible, and these openings should be metal protected to prevent the passage of fire from one story to another. All openings should be finished at the floor by a boss to prevent water from passing from upper to lower floors, scuppers being provided for drainage through the outside walls at the floor level.

4. All walls and internal partitions should be either fire proof or of slow-burning construction.

5. Interior doorways connecting fire units should be protected by automatically closing, fire-proof doors. The windows opening upon all shaft-like areas, such as light wells or small courts, or looking upon other nearby structures, or standing close to an inside angle of the same building, should be provided with metal casings and sash, and with wire-mesh glass. It has been estimated that one-third of the total fire loss is caused

by fire passing from one building to another, through window openings.

6. Stairways, beltways, and elevator ways should be enclosed in slow-burning or fire-proof partitions. In all cases where many persons are to be congregated on upper floors it is important that fire escapes should possess the two following characteristics: first, persons going down should not be obliged to pass in front of any opening of a lower floor from which flames can issue. The connection at each floor should be indirect, that is to say, around a corner or along an unpierced wall. Second, if the fire escape is enclosed, the menace of smoke should be avoided, and the draft action be broken up, by large openings to the outer air at each floor. Two fire-escape designs recommended by "Industrial Engineering"[1] are as follows:

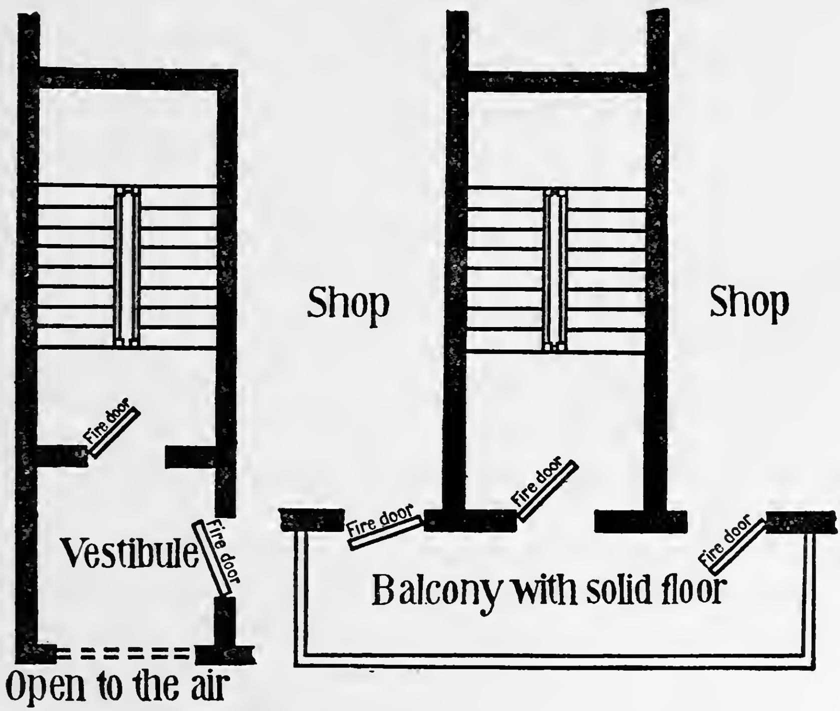

Fig. 24. Fire Escapes with Indirect Approach and Free Air Spaces at Each Floor

[1] October 1913.

7. If the outer covering of a roof is reasonably fire resistant a great source of loss from communicating fires is removed. Skylights and elevator pent houses are critical points in roof construction because, in case of fire, they are caps closing up possible chimneys. The Chicago ordinances provide that skylights must be metal protected in buildings less than 90 feet high, and fire-proof in all higher structures.

8. Fires usually have small beginnings. The main rule of strategy in dealing with them is to get at them early. The essential apparatus for a quick response is an automatic fire alarm, supplemented either by portable extinguishers, or stand-pipe with hose on all floors, or by a system of automatic sprinklers, or by all three.

Automatic sprinklers. — One of the recommendations of the Board of Fire Underwriters of New York, following the disastrous fire of the Triangle Waist Company, was that no factory building containing inflammable goods in process of manufacture, or employing in excess of a limited number of operatives, and over 60 feet high, should be without automatic sprinklers. An automatic sprinkler installation consists of a system of pipes hung slightly below the ceilings, and so distributed that a head or valve will be centrally located over every 80 to 100 square feet of floor space. A fusible link in the head melts at from 155° to 160° F., and starts a water spray. The pipes must be connected with a dependable water supply. It is advisable to supplement the city water by placing a tank above the roof, of sufficient capacity to operate one-half the sprinklers on any one floor for fifteen minutes. If the pipes are to be placed where water would freeze, they may be filled with air kept under pressure by a dry valve, which will admit water to the system upon the opening of any head. As the system is not intended to cope with fires which have gained headway, it is essential to extend it to every part of the risk, or to isolate the unsprinklered portions. When the valves are once opened they continue to play until the water

supply is cut off; it is advisable, therefore, to add an automatic alarm to avoid excessive water damage in case the valves are opened when the building is empty. The National Fire Protective Association has compiled the history of 8,347 sprinklered fires. Of these 7,846, or 94 per cent, were put out by the sprinklers unaided. The failures were due to the water being turned off, insufficient water supply, concealed spaces, fires gaining headway in unsprinklered parts, etc. Fifty-five per cent of these fires were extinguished by 3 valves or less, 72 per cent by 6 valves or less. These facts show the localization of water loss as compared with the general destruction incident to the work of city fire departments.

Insurance companies belonging to the National Board of Fire Underwriters grant a reduction of rates from 30 to 50 per cent for sprinklered risks, depending upon the character of the equipment. For a risk of fair size, the cost of installing can be paid for in a few years out of the saving in insurance premiums; indeed, there are construction companies ready to install the system and take as their pay a part of the insurance saving.

Insurance rates in building finance. — To bring out the powerful influence exerted by insurance rates upon the calculations of building finance, let us take a series of illustrative cases involving different types of construction. Three plans for a two-story building, with dimensions 25x30 feet, were drawn up by the Home Insurance Company in 1910, and submitted to builders in all parts of the United States for bids. The first floor of the building was to be flush with the ground; the height of the eaves was to be 22 feet; the peak of the roof was to be 10 feet above the eaves. The bids in detail averaged as follows: framing with brick walls $1,096, framing with concrete walls $838, wood framing $619, tin roof painted $120, slate roof $129, tile roof $212, shingle roof $87. Allowing $1,500 in each case for inside finish, the cost of construction with different materials was found to be,

Style A. Brick walls and slate roof, $2,725.
" B. Concrete walls and tile roof, $2,550.
" C. Frame walls and shingle roof, $2,206.

Inasmuch as the style of construction affects the insurance, not only on the building, but on its contents as well, it is necessary to take both rates into account. Assuming average conditions as to exposure, moral hazard, etc., the insurance rate per $100 per annum on building and contents, when used for various purposes, would be approximately as follows:

Property	As Dwelling	As Store	As Factory
A Building.........	$0.495	$0.95	$1.4125
" Contents........	0.495	1.0125	1.4125
B Building.........	0.495	0.95	1.4125
" Contents........	0.495	1.0125	1.4125
C Building.........	0.882	2.75	2.3875
" Contents........	0.882	2.6875	2.3875

Let us assume that if the building is used as a dwelling the contents will be insured at $1,500, if used as a store at $3,333, and if used as a factory at $5,000. The annual insurance premiums for each style of construction, used in each of the three ways, will then be, for building and contents, as follows:

Property	As Dwelling	As Store	As Factory
A Bldg. and contents	$20.91	$ 59.64	$109.12
B " " "	20.05	57.98	106.64
C " " "	32.69	150.25	171.99

The differences between the annual premiums are:

	As Dwelling	As Store	As Factory
Between A and C...	$11.78	$90.61	$62.87
" B " C...	12.64	92.27	65.35

The differences in original cost are:

Between A and C........	$519
" B " C........	344

If we divide the difference in the cost of the structures by the difference in the annual insurance premiums, without allowing anything for interest, we find that the saving in premiums will equal the difference in the cost, in the following periods of time:

	As Dwelling	As Store	As Factory
Between A and C...	44 years	5.7 years	8.1 years
" B " C	27 "	3.7 "	5.3 "

If we take interest into account, compounding annually at 6 per cent on the sums represented by the differences in first cost, and putting the differences in the premiums into a sinking fund compounding at 6 per cent, we can discover in what periods of time the saving in premiums will equal the difference in cost of construction. It is obvious, at once, that the saving in premiums, when the structure is to be used as a dwelling, is not sufficient to extinguish the difference in first cost. When, however, we turn to the premiums which must be paid when the structure is used as a store or as a factory, we perceive the decisive effect of the premiums paid on contents. The periods in which the premiums saved will extinguish differences in cost, when compound interest is calculated, are:

	As Store	As Factory
Between A and C..	A little over 7 years	A little over 11 years
" B " C..	About $4\frac{1}{3}$ years	Abcut $6\frac{1}{2}$ years

From this it can be seen that cheap, inflammable forms of construction, to be used for store or factory purposes, have no standing whatever in a rationally financed plan.

Nor does the insurance premium involve the whole case.

There is usually an uninsured hazard. Furthermore, the expenses of maintenance and depreciation are generally higher on inflammable than on slow-burning or fire-proof construction. The annual rates of depreciation on the above-described structures, as furnished by engineers from all parts of the country, averaged for A style 1.11 per cent, for B style 1.27 per cent, and for C style 3.47 per cent. In addition the C type building is subject to an extra expense of from $20 to $30 for painting every four years, and to an extra annual heating bill, estimated for the northern parts of the country at $20. Taking all these various items into consideration, the net rent of A and B structures for 20 years has been calculated at 7.77 per cent on the investment; that for C structure at 5.16 per cent.

Safe operation. — Some points of good practice in the operation of shops, to lessen fire risks, are as follows:

1. The segregation of hazardous processes, and of all but the daily requirements of such substances as gasoline, should be complete.

2. Sharp supervision should be given to wastes and oily rags and dust preventives, and to all materials containing vegetable oils which oxidize at low temperatures. Metal waste cans are now to be had which can be conveniently opened and closed by means of a foot lever.

3. The alignment of shafting, and the condition of all hangers should receive regular attention. The stages of a shafting fire are, first, combustion of the oil and waste at the bearing as the result of excess friction from lack of alignment; second, the melting of the Babbitt metal of the bearing; third, the drip of this hot metal, together with burning drops of oil, to the floor; fourth, general conflagration.

4. Smoking should be prohibited during work hours and in work apartments and stock rooms.

5. The idea of a fire drill at frequent intervals should be carried from our schools to our factories. If fire-fighting appa-

ratus is installed by employers, preliminary exercise in its use is as intelligent a thing as military drill is for war, or boat drill is for Atlantic liners.

Heating and Ventilation

Inadequate heating and ventilation cause inefficiency through sickness, lowered vitality, and the inferior average of ability which results from the fact that those persons for whom employers compete actively will select comfortable surroundings. The employees of the United States Pension Bureau averaged 18,736 lost days per year on account of sickness, while they were housed in poorly ventilated buildings. When the Bureau was moved to its present well-equipped quarters, the losses fell to 10,114 days per year. The Telegraph and Telephone Company of Cambridge, Mass., employing between 50 and 60 girls, with poor ventilation in 1906 averaged 4.9 per cent of the force absent, and in the following year 4.5 per cent. When good ventilation was provided the absences fell to 1.9 per cent.[1]

Good air. — Ideal heating and ventilation consists in distributing, without injurious draft, an adequate supply of air of the proper temperature and degree of humidity, and free from dust and noxious gases. The traditional criterion of the quality of air has been the percentage of carbon dioxide (CO_2) in it. It has been held that, in first-class practice, the proportion should not exceed 6 parts per 10,000, while the maximum allowable was from 9 to 12 parts per 10,000. To attain a standard of 6 parts per 10,000 requires an hourly supply of 2,500 cubic feet of fresh air per individual. The emphasis in ventilation is now placed by physiologists entirely upon the temperature and humidity of the air. Experiments appear to show that air is bad chiefly by reason of conditions which interfere with the proper functioning of the skin in regulating the temperature of the body.

[1] C. E. A. Winslow, Factory Sanitation and Efficiency, Industrial Engineering, June 1911, p. 46.

Temperature. — A winter temperature of between 60° and 70° F. should be maintained in manufacturing departments, and somewhat higher temperatures in office departments. With vigorous exertion 55° to 60° F. is not uncomfortable, but if labor is intermittent, or the quick and accurate use of the fingers is necessary, a temperature of 60° to 65° F. is better. Heating calculations must take into account the type of building construction, area of outside walls, window areas, velocities of the wind, outside temperatures, isolation, rate of change of inside air, and the heat generated by persons, lights, and machines.

Humidity. — The capacity of air to absorb moisture vapor increases with its temperature. If outside air at 75 per cent humidity, and at temperatures of 10°, 20°, or 30° F. be heated to 65° F., it becomes desert-like in dryness with humidities of 8.5, 14, and 21 per cent, respectively. Air of this degree of dryness sucks moisture energetically from everything with which it comes in contact. Some processes, such as textile spinning and cigar making, are impossible in such air. Upon workmen the effect is bad: the membranes of the nose and throat become parched, while the dust raised by the dryness of surrounding objects contributes to increase irritation. The Chicago ordinances require that the humidity of factories shall be kept between 40 and 85 per cent. The normal humidity of out-door air may, perhaps, be taken as 65 per cent. This is an acceptable standard for inside practice.

Ventilating and heating methods. — The ordinary system of ventilation is to depend upon the natural porosity of building materials, and to get an occasional change of air by the time-honored device of opening the windows. The ordinary method of heating shops is to attach steam pipes to the outside walls. Such equipment is expensive in fuel and in the upkeep of piping, and does the job poorly. A sheet of hot air flows upward along the windows and outside walls, cooling rapidly as it passes, and finally takes its place as a bank of warm air next the roof or

ceiling. Meanwhile the central and lower parts of the room remain cold. The ideal system is indirect radiation and mechanical ventilation. The apparatus required consists of an intake and fan, a battery of coils for heating or cooling, a chamber of cold water sprays or steam sprays to regulate humidity, a system of fresh air supply pipes of properly graduated dimensions and proper sized openings, together with corresponding ventilators for the outflow of used air. With such a system about one-fourth as much steam piping is required as with direct radiation, for the fan drives the air rapidly over the heating coils. The piping, also, is conveniently concentrated for repair in a basement location, where leakage can do no harm.

Artificial Illumination

It has been said that man, in the productive process, can do nothing with materials, beyond moving them from place to place where they are variously acted upon by natural forces. The sense most employed in locating things is sight. This sense, in our latitude, must be aided, for about 15 per cent of the working day, by artificial illumination. The expense of good illumination is a negligible factor in comparison with its efficiency. One of the most expensive forms of lighting is the incandescent carbon-filament lamp. The cost of operating a 16 candle-power lamp of this character is about one-half cent per hour. If a workman receiving thirty cents wages per hour is hindered one minute by defective illumination, the wage loss alone, to say nothing of fixed charges, is sufficient to provide a lamp for an hour. If a workman loses ten per cent of his efficiency during working hours because of poor light, the wage loss would keep six lamps going during the entire day. Flexner and Dicker have estimated the cost of one 100-watt lamp for each man, burning $3\frac{1}{2}$ hours per day, at $6.36 per year.[1] If a

[1] Good Illumination as an Accident Preventer, Proc. of Illuminating Engineering Society, 1914.

workman receives $1,000 a year in wages, the cost of lighting is but about $\frac{3}{5}$ of 1 per cent of the payroll.

Essentials. — The essentials of an adequate system of illumination are, 1, sufficient amount; 2, proper distribution and diffusion; 3, absence of glare; 4, freedom from fluctuations, and, 5, freedom from injurious invisible radiations.

Intensity. — The light intensity required for the illumination of yards, paths, and warehouses, where men must be able to see general inequalities and large obstacles, and must have sufficient light to load and unload coarse materials, operate cranes, and handle large tools, will vary from 0.15 to 0.5 foot candles. The general illumination of machine shops should be between one and two foot candles. For the reading of blue prints and the close inspection of work in machine shops, and for desk work in offices, the intensity should be between 3 and 6 foot candles. Drafting rooms call for from 4 to 6 foot candles.

Distribution and diffusion. — The difficulty of distribution lies in providing an intense illumination for the particular field of a man's work, while giving to the room as a whole an economical general lighting of low intensity; and yet, in doing these two things, to avoid the necessity for any individual pair of eyes making the change from one degree of illumination to another frequently or rapidly. A satisfactory solution of the problem requires the careful location of small, individual, hooded lights, set close to the work, and the general illumination of the apartment by high-placed, open lights of greater power. It requires, also, such a division of labor in the shop or office as will permit each person to work in one plane of illumination, as far as possible.

The control of the reflection of light from non-luminous objects in an apartment is quite as important as the proper subdivision and location of the primary light sources. The field upon which a workman's eyes are focused at any moment is but a minute fraction of the total area which must be illuminated. Economy

in the use of illuminant demands, therefore, that the objects at which the workman is not looking should reasonably reflect back the light radiated to them, and thus assist in the illumination of the object on which the eyes rest. It has been said that a 20 candle-power light will give as much illumination in a room with white surfaces as 100 candle-power will give in a black room. It is good practice to paint ceilings and walls and posts a light color. By this means a diffused and soft light, very agreeable to the eyes, is produced.

Glare. — Glare is the dazzling or blinding effect produced by excessive light. The word is used to signify the more or less temporary injury of the retina by intense light. It also designates delay in accommodation, or the inability of the pupils to at once take in sufficient light for definition, when dropping from a high to a low degree of illumination. A third signification of glare is that a pupil which is taking in light from an intense source cannot, at the same time, open widely enough to give proper definition of less brilliantly illuminated objects. A workman who has a dazzling light source or reflection in his field of vision, and who is vainly trying to see a moderately illuminated piece of work, may complain of insufficient light, when he is really suffering from excess of light. If the brilliant light is excluded from the eyes, the pupils dilate so that the work is seen, and the trouble disappears.

As the progress of illumination engineering causes new and increasingly intense light sources to be brought into use, the danger of glare is increasing. It has been advanced as a good general rule that no one should be exposed to the frequent view of any luminous object the brilliancy of which exceeds four candle-power per square inch. As the intensity of the gas mantle is about 32.5 candle-power per square inch, and of the carbon-filament 558 candle-power, and of tungsten, tantalum, and arc lamps much more, this rule can be interpreted to mean that no light sources, and no mirror-like or undiffused reflection of the direct rays from such a source, should be directly visible.

Building Contracts

The various forms of building contracts may be classified under four heads, with reference to the manner in which the financial relations between the owner and the contractor are determined.

1. Lump-sum contracts, or the form in common use at the present time.

2. Cost-plus-a-percentage contracts, with or without a guarantee not to exceed a stated maximum.

3. Cost-plus-a-fixed-sum contracts, one modified form of which provides a theoretical cost, and establishes a sliding scale of bonuses if actual cost is less, and of penalties if it is more.

4. Unit-price contracts, providing a series of prices according to which all materials furnished and put in place are to be paid for.

Lump-sum contracts. — Under this plan the owner provides complete drawings and specifications, on the basis of which contractors bid by naming a sum for which the work will be done. The lowest bidder secures the work, unless there is a clause employed which permits the owner to reject any or all bids.

Among the advantages of this system the following points may be mentioned:

1. It necessitates clear and complete specifications and drawings. In the preparation of these the owner is likely to determine exactly what he wants before he calls for bids. The bids enable the owner to know at the start what the work will cost, so that he can promptly take the necessary steps to finance himself.

2. The contractor, likewise, knows from the moment his bid is accepted what materials and laborers will be necessary, and what his remuneration will be.

3. In the competition of bidding there is definiteness and simplicity. The plans are handed out; the bid is a single figure.

The disadvantages include the following points:

1. The labor of arriving at bids is considerable. The owner must endeavor to foresee and provide for every contingency in the plans. The bidder must forecast all that might arise in the doing of the work. The labor of making such advance calculations is labor lost to bidders who fail to land the contract.

2. On work of any magnitude, such forecasts are seldom accurate. If the contract contains clauses which place much arbitrary power in the hands of the supervising architect, it is impossible for the bidder to tell what will happen. On the other hand, if changes or additions are made as work progresses, the contractor has a chance to bring in the much-dreaded bill of extras; and he has, also, an excuse for not finishing the work on time.

3. When physical uncertainties exist, such as the chance that work on footings will reveal quicksand, or tunnelling work will encounter rock, a contractor may be made a bankrupt or may pocket unreasonable profits. A contractor specializes upon labor, materials, and work processes, and so is a manufacturer rather than a trader. He is usually not equipped to carry speculative risks: and he cannot make the thoroughgoing investigations which will avoid them, so long as he is a mere bidder uncertain of obtaining a contract. The owner is to possess the finished work, and it seems as fair that he should pay exactly what it costs as that he should pay an average or standardized cost.

4. The greatest objection which can be made against the lump-sum contract is that it arrays the owner, with his engineer or supervising architect, squarely against the contractor, making the interests of the two as opposite as possible. This antagonism prevents these persons, who usually have different kinds of knowledge and talent, from working in harmony. It is this antagonism which makes loop-holes and extras dangerous, and which makes necessary elaborate specifications and rigid systems of inspection.

Cost-plus-a-percentage contracts.— Under this plan the contractor agrees to furnish all the materials, labor, superintendence, and equipment necessary for the doing of a given piece of work. This he agrees to do at cost, taking his own remuneration in the form of a percentage — 10 to 15 per cent — calculated on the cost. There is sometimes an arrangement that the cost is not to exceed a specified amount.

The advantages may be first considered.

1. There is no dispute between the parties as to the qualities of materials or the character of the workmanship to be used, and very little as to the rate of advancement of work. The owner has his way and pays for it. The contractor has no reason to withhold advice which will lower the cost for, if he earns less for the job, the lowering of cost usually means the elimination of slow kinds of work, so that his rate of earning in terms of time is increased.

2. Plans may be changed as the work advances. This is convenient in cases where the specifications are poor or the drawings full of imperfections.

3. Time may be saved by starting work promptly. The specifications relating to later stages of the work can be prepared while the earlier classes of work are under way.

4. The contractor, by being relieved of worry as to the weather, cost of materials, etc., has his mind free for the problem of doing the work in the best possible manner.

5. The owner has every motive to refrain from unreasonable demands. He is quickly educated by the cost reports he receives.

Passing to the disadvantages, we find:

1. The elasticity of the plan encourages the starting of operations before plans have been well thought out, and before the cost has been reasonably counted by the owner.

2. Trouble may arise in any "cost plus" contract as to what items may properly be included as cost. If the contractor furnishes derricks and tools and wagons, what charge should be

made for them? How shall the use of the contractor's buildings and storage yards and office force be charged for?

3. Contracts based on cost are obviously open to the fraud of secret rebates. If the contractor does not take these rebates for himself, he may nevertheless fail in diligence in securing them for his employers.

4. There is an idea among workmen that it is justifiable to "soldier" at an owner's expense, whereas to soldier on a contractor is to rob him of his living. This idea workmen are made bold to apply, since they understand that the owner will not soon be on the market for labor again. The contractor has not the incentive to manage with energy, except as speed increases the number of jobs he can handle in a season.

5. The largest costs roll up in a given time when easy, commonplace, standardized forms of work are under way. The contractor will find it little to his interest to do fine, difficult, or unusual work, which requires careful supervision, but upon which the percentage earnable per week is low.

6. The owner, who is at best an intelligent amateur, may be overstimulated, so that he attempts to dictate in matters which he does not understand. A dispute as to the division of administrative authority may arise unless decisive clauses are in the contract.

Cost-plus-a-fixed-sum contracts. — This plan provides that the owner shall pay the cost of a piece of work, and an additional fixed sum as the contractor's profit.

The plan was devised to avoid the premium on sloth which the percentage plan was thought to offer. By pushing his work through energetically, the contractor gets his reward without diminution and in a shorter time.

The defects of the plan are similar to those of the cost-plus-a-percentage plan, except for the premium on sloth.

Unit-price contracts. — The unit-price plan involves a schedule of agreed rates at which the owner will pay the contractor for various classes of materials, when finished and

set in their places in the structure. It is a sort of lump-sum contract calculated for each unit of work: or it is a species of piece-rate applied to contract work. Sometimes a maximum amount to be paid for each kind of work is stipulated.

The merits of the unit price may be designated broadly by saying,

1. That it pays accurately and exactly for what is done, and for that only.

2. It puts a premium on speed, as does the cost-plus-a-fixed-sum contract or the lump-sum contract.

There are several disadvantages:

1. The interests of contractor and owner tend to draw apart as in the lump-sum contract.

2. To protect the owner in the matter of quality, and to determine the quantities for which payment is to be made, "quantity surveying" becomes necessary. If the construction to be paid for is a simple thing, such as an earthen embankment, a single survey at the conclusion of the work is sufficient. In architectural construction, however, where one material covers another, repeated surveys must be made, so that the plan becomes expensive. "Quantity surveying" is common in England, where the salaries of engineers and inspectors are much lower than they are in America, and where construction methods do not so greatly emphasize speed.

3. Rival bids submitted under this plan can be compared with difficulty. It is asserted that it is possible to prepare deceptive bids, in which the more prominent rates are low, while "jokers" are hidden away where they will attract little attention until operations are begun.

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CHAPTER VI

POWER

It has been said that, of the thousand million dollars paid out annually in the United States for the coal burned under boilers, from one-eighth to one-fourth could be saved, if first-class apparatus were used, and if the principles accepted by the engineering profession as controlling the efficiency of the consumption of fuel were put into practice.

Power problems. — The questions which arise in administering a power plant fall, broadly speaking, into three groups. The first of these has to do with the purchase of fuel on the basis of its fuel value, and its appropriateness for the furnace in which it is to be used. A proper check should be kept upon the amounts of fuel received and used, the endeavor being to hold in storage only such a reserve as will insure regularity of operation. The second class of problems is concerned with the installation of furnaces and boilers, together with a more or less extensive equipment of auxiliary apparatus, such as mechanical stokers, superheaters, condensers, water softeners, and mechanical draft. The operation of this equipment involves, among other things, the control of the vital process of stoking. The third set of problems is concerned with transmission, and involves not only the construction of a system of shafting, belting, wiring, and piping, but the supervision necessary to keep this widely scattered apparatus in a state of efficiency with reference to power absorption.

Qualities of coal. — The customary way of purchasing coal is to judge the value of a new fuel by one's impression of the

district from which it comes, by the personality of the selling agent, or by the standing of concerns which are mentioned as users of it. If a new fuel is given a test, its fate is likely to turn upon its brightness, or the amount of dust in the sample car, or what the firemen say of it.

The calorific power of coal depends upon the number of heat units it will produce. The heat unit, known as British thermal unit (B.T.U.), is the amount of heat required to raise one pound of water one degree in temperature — from 39° to 40° F. — at the sea level. A fair range of the thermal power of steam coals is from 10,000 to 15,000 B.T.U. per pound. The combustible element in coal is divided into volatile and fixed carbons. The volatile carbons vary from 5 per cent in hard coals to between 40 and 60 per cent in soft coals, calculating on a dry coal basis. The fixed carbons range from 50 per cent in soft coals to 85 per cent in anthracite. The market prices of coals vary approximately with the percentage of fixed carbon, for the reason that special equipment and expert handling are required to obtain good results from the volatile elements. For this reason coal users who are equipped to handle volatile fuels will usually find that the cheapest coal is the best value for them. A rich soft coal carelessly handled means that as a quantity of fresh fuel is thrown onto the fire by the fireman, great volumes of gas will be distilled to escape unburned to the air, while volumes of smoke will pass up the chimney coating all flues and boiler surfaces with an insulating layer of soot. Coal contains varying amounts of moisture which serve to lessen its value, not only because water is not fuel, but because there is required from ten to fifteen pounds of coal to evaporate one hundred pounds of water in a furnace. Inasmuch as the moisture element in coal may vary from day to day, and from one part of a stock pile to another, it is necessary to make comparisons of different fuels on a dry coal basis. Ash is earthy matter of no fuel value. In commercial coals it varies from 4 to 25 per cent. A high-ash content increases the expense of every operation,

such as carting, stoking, slicing, drawing, and dumping. Coals high in ash burn poorly because of the obstruction offered by the inert matter. They entail extra labor in cleaning the dust from the flues. The importance of the ash depends partly upon its tendency to fuse and form a clinker which cements itself into a sheet in the lower part of the bed and shuts out the air from the burning fuel above. There are various minor constituents of coal, such as sulphur and phosphorus which, if present in large quantities, may give trouble by attacking the metal parts of the furnace and boiler.

The size of the lumps or particles of coal is important, uniformity of size being a merit. When different sizes are used together the fine particles tend to sift into the interstices between the larger lumps and make a bed so compact that air does not readily pass through. Very fine coal is difficult to handle: if a thick bed is used the draft is poor; if a thin bed is resorted to the dust sifts through the grate, or spots burn out leaving holes in the bed through which the draft is lost. If the draft is strengthened dust is blown onto the flues and out of the chimney.

Specifications. — The scientific way of buying coal is on the basis of detailed specifications. It is as reasonable to buy coal on analysis as it is iron ore or metals or fertilizer. The central point of a coal contract is the agreement that the fuel shall be paid for on the basis of a given number of B.T.U. — say 125,000 — for one cent. In important cities in the eastern part of the United States a commercial consumer will pay from 10 to 12 cents per 1,000,000 B.T.U. In order to designate the character of the fuel to be bought, a contract should contain a guaranteed approximate analysis, and limits of allowable variation. The size of the coal may be controlled by describing the screens over which and through which it should pass. Other parts of the contract will refer to dates of delivery, and to the procedure to be followed in case of non-performance.

Effect of transportation on value. — There is an important influence upon the relative values exerted by the transporta-

tion expense incurred in shipping coals of different composition to the place of consumption. The difference of caloric value between two fuels remains constant whatever their price or location. The laid-down prices of two fuels tend, however, toward a parity as the freight charge increases. If, for example, two kinds of coal, one *A* of 13,500 B.T.U. per pound, and one *B* of 14,500 B.T.U., sell at the mine for \$1.05 and \$1.25 per ton, respectively, the ratio of quality is $\frac{13{,}500}{14{,}500}$ or $\frac{93.1}{100}$, while the ratio of prices is $\frac{1.05}{1.25}$ or $\frac{84}{100}$. The B.T.U. of *A* is 93.1 per cent of the B.T.U. of *B*, while the mine price of *A* is only 84 per cent of the mine price of *B*. If we assume that the B.T.U. represent the relative fuel values to any individual buyer, it is clear that *A* is the better purchase at the mines. If we ship both coals, and pay \$1.50 freight per ton on each, the price ratio is altered as follows:

$$\frac{1.05}{1.25} + \frac{1.50}{1.50} = \frac{2.55}{2.75} = \frac{92.7}{100}$$

The price of *A* becomes 92.7 per cent of the price of *B*. These prices are closely in accord with the relative fuel values. But if, however, we pay a freight of \$3.00 (which is about the average charge from Eastern coal fields to interior points in New England), the price of *A* and *B* are related thus:

$$\frac{1.05}{1.25} + \frac{3.00}{3.00} = \frac{4.05}{4.25} = \frac{95.3}{100}$$

The price of *A* becomes 95.3 per cent of *B*, but since the fuel value remains 93.1 per cent, the higher grade and higher priced coal becomes the more economical of the two. Transportation enhances the relative worth of superior qualities of all materials.

Storage and handling. — The amount of coal which should be carried in reserve depends upon the rate of consumption, the effect of weather upon the type of fuel used, the cost of storage space, and the liability of railway or mine strikes or other interruptions to supply. The prevailing idea is that a two weeks'

supply is about right. The best modern practice in handling consists of unloading from self-dumping cars into pits below the track, automatic elevation into concrete overhead bins in the boiler house, and gravity feed to the furnaces. Some advantages of such installation are a saving of from one-fourth to one-half in handling cost over shoveling and teaming, the preservation of the coal dry and unfrozen, safety from theft, and economy of ground space.

Requirements for combustion. — A furnace is a device in which the combustible elements of coal are volatilized by heat, and mixed at high temperature with a regulated supply of air, to bring about fairly complete combustion. The essential conditions for efficient combustion may be indicated broadly under seven heads.

1. Fuel should be introduced as evenly as possible, in order that the distillation of combustible gases may be uniform. In case of hand firing, small amounts of coal should be introduced frequently and spread evenly over the grates. The automatic stoker accomplishes the gradual introduction of fuel, without disturbing the drafts.

2. The fuel should be of uniform size, so that the draft will be uniform through the grate at all points.

3. Air must be admitted in sufficient quantities, that is to say, in proportion to the rate of distillation of gas from the fuel.

4. Ample space must be allowed for the gases and the air to become thoroughly mixed.

5. This mixing must take place at a high temperature, if combustion is to result. A more or less enclosed combustion chamber of fire brick should be provided. The temperature of combustion of carbon is from 1600° to 1800° F. The temperature of boiler surfaces is below 400° F. It is manifest, therefore, that if any unburned gases come in contact with the shell or tubes of a boiler they will become so cooled that combustion will not take place, and they will be lost in the flue gases. The process of evolving heat in gases by combustion must be com-

pletely separated from the process of drawing the heat out of these gases into the boiler. A mixing chamber can be formed by constructing a heat-reflecting roof over the fire bed, which will confine the fire in an oven. To be certain that combustion is completed, there should be provided a special combustion chamber to the rear of this by hanging a tile roof from the bottom tier of boiler flues. The length and direction of the

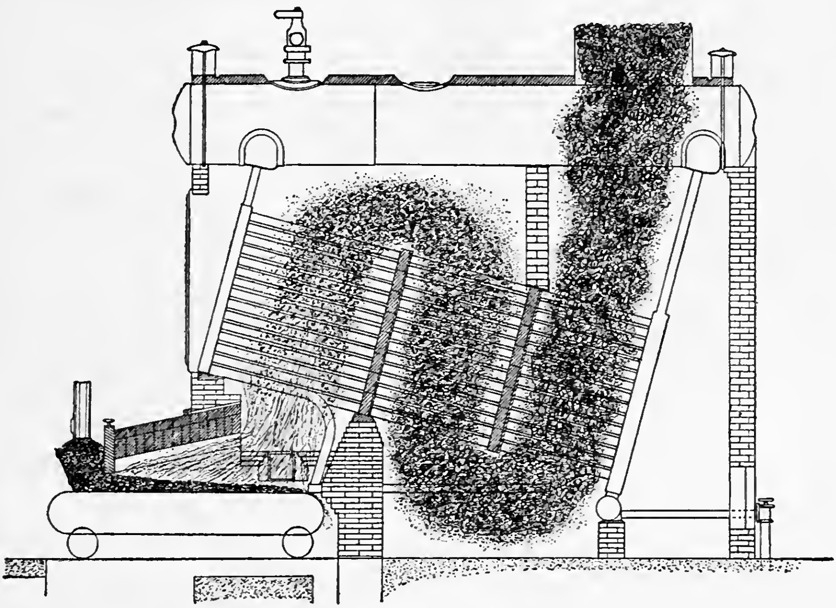

Fig. 25. Imperfect Furnace Design

The partly-burned particles of carbon are quenched by premature contact with the cool surfaces of the boiler, with the result of producing smoke and wasting fuel.

travel of gas through the flues can be controlled by tile baffles. A contrast between good and bad furnace design is presented in Figures 25 and 26.

By providing a mixing chamber the process of combustion is completed before the absorption of heat by the boiler is begun. The result is smokeless combustion and efficient use of fuel.

6. Overloads should be avoided as far as possible. A furnace designed to burn a given amount of fuel in a stated time is in perfect balance only when doing that quantity of work.

7. The furnace and the fuel must be adjusted to each other. After a boiler room has been equipped, and the proper type of coal has been decided upon, there should be as little variety as possible in the fuel provided.

Firing systems. — There are three methods of hand firing: the coking system, the alternating system, and the sprinkling system. The coking system consists of piling the green coal on

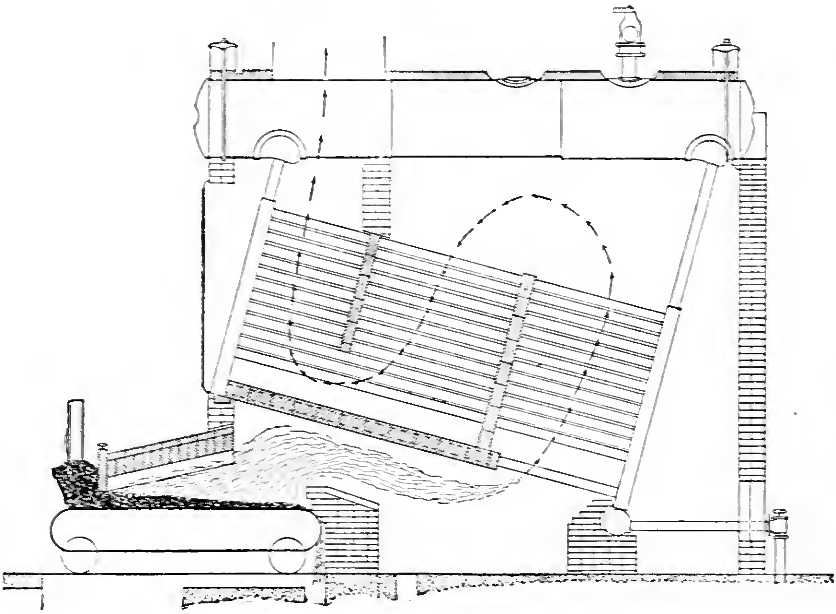

Fig. 26. Good Furnace Design

the dead plate inside the door, or on the front third or fourth of the grate, and allowing it to remain there for 20 to 30 minutes, until the volatile hydro-carbons have been driven off. This coked fuel is then pushed back evenly over the remainder of the grate, and a new charge of fuel is inserted in front as before. To secure good results, the air should be admitted through the door, so that it may mix with the gas driven off during the coking process. The furnace should be provided with a low roof to force the air and gas to travel backward close to the hot fire and be raised to high temperatures. At the rear of the grate

it is an advantage to have a bridge wall with vertical baffles to ensure thorough mixing. The coking system is suited for bituminous coals which are rich in volatile matter. It cannot be used with anthracite or non-coking coals. This method of firing is little practised in the United States, but is used in marine work in all parts of the world, and in stationary engine practice in European countries.

The alternate system of firing consists in replenishing the fuel first on one side of the grate and then on the other. The idea is to avoid cooling down the entire bed at once. A bright bed is left on one side to provide air and highly heated gas, while from the freshly covered side come rich gases of lower temperature. Precautions must be taken in the construction of an alternating furnace to insure the thorough mixing of the gases of the two sides. Two doors are required.

The sprinkling or spreading system consists of the even distribution of a thin charge of coal over the entire grate surface at frequent intervals. The new charge should especially repair the thin spots in the fire, the idea being to have the bed offer the same degree of resistance to the passage of air in all of its parts. A new charge should not be spread until the volatile elements have been driven off the last one, and the bed has become reduced to a porous layer of burning coke. This is the system aimed at, but not often achieved with notable perfection, by common practice throughout the United States.

Firemen's rules. — Firemen should be instructed to add fuel frequently and in small amounts, so that volatile gases will not be liberated more rapidly than air can be mixed with them. A large mass of cold fuel thickens the bed, chills the fire, and diminishes the draft. A fireman who pokes a fire to stimulate the burning of green fuel does not understand his job. Poking is properly slicing, the object of which is to break up cakes of coke and clinker. It precedes charging rather than follows it, hastening the burning of the bed down to the point where fresh fuel is called for. It is bad practice to allow a fire to run

up so high that severe checking is needed: The sudden cutting off of air while there is evolution of gas means wasted fuel. A skilful fireman will avoid the need of sudden checking by using the injector to regulate steam pressure.

Mechanical stokers. — Stoking is a difficult art, being in reality the supervision of a complex chemical process of distilling and mixing gases. But, as a form of labor, it is attended with so many unpleasant features that it is difficult to secure a steady force of men with sufficient intelligence to realize the possibilities of the work. The first effort to solve the problem by invention was in 1822, when a mechanical stoker of the sprinkler type was brought out in England. The first American stoker was built by Thomas Murphy of Detroit, in 1878, and was a double sloping grate. Mechanical stokers may be classed as inclined grates, chain grates, and underfeed furnaces. The inclined grate will burn coking coals, for the bed is broken up by the process of shaking down the fuel from a higher to a lower level. Chain grates do not break up the bed but travel with it from front to back; coking coals cannot be used on them. But the chain grate permits a thinner fire, and so a lower grade of fuel. The speed of the grate and the thickness of the bed must be mutually adjusted. If the speed is too fast, unburned fuel will be dumped; if too slow, the rear of the grate will become bare. Run-of-mine coal must be burned in a thick bed to prevent the fine particles from falling through into the ash pit. The chief claim of the underfeed grate is smokelessness. New fuel is forced in under the burning bed, so that the particles of carbon driven off by the first combustion are forced upward through the hot crown and are gasified. The fuel bed is so deep in underfeed grates that forced draft is required. The ash remains a long time in the hottest part of the fire, so that if it is of a fusible nature it melts into a solid clinker.

The points of advantage of a good mechanical stoker are economy of labor (one fireman should handle from 8 to 10 stokers), economy of fuel, ability to utilize low-grade fuel,

increased efficiency of boilers, and longer life of boilers. The minimum-sized plant which can advantageously use mechanical stokers is probably one of 500 horse power.

Draft. — Natural draft depends upon the difference between the weight of a column of warm air in a chimney and the weight of an equal volume of cool outside air. The lower the temperature at which gases enter a chimney, the higher must the chimney be to ensure a given force of draft. Draft economy, therefore, balances the loss in hot gases over against the cost of a tall chimney. In good practice, coal should not be burned faster than 35 to 40 pounds per square foot of grate per hour; and the gases entering the flue should not be over 500° or 600° F. With mechanical draft expensive chimneys can be avoided, at the expense of steam consumption to operate a fan. Mechanical draft permits the use of low-grade fuels; it overcomes the retarding effect of an economizer; it permits overloads to be more quickly taken care of; and it permits of the regulation of draft automatically by steam pressure, and independently of temperature and barometric conditions.

Boiler design. — The aims of boiler design are to cause the inside water and the outside gases to flow in opposite directions for the maximum travel at maximum speeds, to secure the shortest passage for steam from its place of origin to the steam chest, to prevent excessive fluctuations of pressure and, in general, to provide a simple, durable, flexible, and accessible piece of apparatus. The aim of boiler house design is to separate engines and boilers, and secure a system of steam mains which is as short as is consistent with the ability to cut out any unit for cleaning or repairs.

Economizers. — An economizer is a collection of heavy, vertical, feed-water pipes, located between the boiler and the chimney. It is used for the purpose of saving a portion of the heat which remains in the gases after they have passed beyond the boiler surfaces. If an economizer has the capacity to reduce the temperature of the flue gases from 600° to 300° F. it will be

able to heat the feed water to 150° F., and effect a 15 per cent economy in fuel. Economizers increase boiler capacity at a less cost than boiler additions. They help to care for sudden overloads by providing a quantity of partly-heated water which can be drawn upon. And they serve to precipitate a large part of the scale in a place where it can be easily disposed of.

Shafting losses. — Ordinary practice in the transmission of power by belting and shafting is poor. It is calculated that losses average from 35 to 45 per cent of the power developed by the engine. These wastes result from excessive journal friction produced, (*a*), by incorrect design, as by the use of high stresses with large pulleys on heavy, slow-moving shafting; (*b*), by incorrect arrangement, as in the taking off of large amounts of power at the ends of the shafting; (*c*), by bad alignment, which means that the shaft not only rolls in its bearings but is twisted by them.

Losses may be reduced by the use of hollow shafting of small dimension, revolving at high speed, and fitted with small pulleys. Alignment, in good practice, should never show a deflection of more than $\frac{1}{100}$ of an inch per foot. By the use of roller bearings as much as one-third of the shafting losses may be avoided: by the use of ball bearings, two-thirds may be avoided.

Belting. — In a notable report presented before the American Society of Mechanical Engineers in 1894, Mr. F. W. Taylor, the founder of scientific management, communicated the results of nine years of continuous experimentation with belting. Among his conclusions were the following points.

1. "The number of square feet of double belt passing around a pulley per minute to transmit one horse power is, for oak tanned and fulled leather belts, 80 square feet, for other types of leather belts and 6 to 7 ply rubber belts, 90 square feet.

2. "The belt speed for maximum economy should be from 4,000 to 4,500 feet per minute.

3. "The best distance from centre to centre of shafts is from 20 to 25 feet.

4. "The faces of pulleys should be about 25 per cent wider than their belts.

5. "When it is necessary to run night and day through the week without stopping, each important belt should be supplied with an idler pulley which can be tightened upon it while running, in case of slip.

6. "Idler pulleys work most satisfactorily when located on the slack side of the belt, about one-quarter way from the driving pulley.

7. "Belts are more durable and work more satisfactorily made narrow and thick, rather than wide and thin.

8. "It is advisable to use double belts on pulleys 12 inches diameter or larger. It is advisable to use triple belts on pulleys 20 inches diameter or larger. It is advisable to use quadruple belts on pulleys 30 inches diameter or larger.

9. "As belts increase in width they should also be made thicker.

10. "The ends of the belt should be fastened together by splicing and cementing, instead of lacing, wiring, or using hooks or clamps of any kind.

11. "Belts should be cleaned and greased every five or six months.

12. "Belts should be tightened and repaired and cared for out of working hours by one man as far as practicable; careful inspection as to their condition being made at regular intervals.

13. "The most economical average total load for double belting is 65 to 73 lbs. per inch of width, *i.e.*, 200 to 225 lbs. per square inch section. This corresponds to an effective pulling power of 30 lbs. per inch of width.

14. "The total life of belting, cost of maintenance and repairs and the interruptions to manufacture caused by belts, are dependent upon the total load to which the belts are subjected more than upon any other condition. The other con-

ditions chiefly affecting the durability of belting being, 1st, whether spliced, or fastened with lacing or belt hooks; 2d, whether they are properly greased and kept clean and free from machine oil; 3d, the speed at which they run.

15. "The speed at which belting runs has comparatively little effect on its life until it passes 2,500 to 3,000 feet per minute."[1]

Electric drive. — When electric transmission is used to convey energy to motors attached to lines of shafting by which groups of machines are operated, the system is called group drive. When energy is transmitted to motors attached directly to individual machines, the system is individual drive. Group drive is best where a number of small machines — below 5 h.p. each — are to be driven at like speed and with little variation of load, as in spinning, weaving, or shoe manufacturing. Individual drive is better suited for large machines, such as cranes, presses, and large planers, which are to be used intermittently,[2] and with great range of speed and load.

Advantages of electric transmission. — The advantages of the use of electric power in mills and factories have been enumerated with excellent thoroughness by Prof. F. B. Crocker,[3] as follows:

1. A real economy in the amount of power used.
2. A reduction in cost of the construction of buildings, which can be lighter, owing to the fact that there is no need to install heavy lines of shafting and pulleys.
3. A reduction in expense of service, such as oiling, depreciation, etc.

[1] Notes on Belting. Trans. of Am. Soc. of Mech. Engineers, Vol. 15 (1894), No. 618, pp. 204–259.

[2] To illustrate the intermittent use of power in engineering establishments, the case of the Milwaukee Bridge Co. may be cited. With 23 individual motors aggregating 149 horse power, they found it necessary to use a central boiler of 75 horse power only.

[3] The Electric Distribution of Power in Workshops, Journ. of Franklin Inst., Phila., Jan. 1901, Vol. 51, pp. 1–7.

4. More efficient arrangement of machines and tools, which need no longer be placed in straight lines parallel with the shafting, but can be located exactly as desired.

5. Access to the machinery is easier from the suppression of belts and pulleys.

6. Greater cleanliness, as there is less dust and no scattering of oil or steam, etc.

7. Hygienic conditions are improved, owing to the diminution of dust and dirt; better light, owing to the absence of shafting, pulleys, etc.; the lessening of noise, etc.

8. Greater ease of placing different shops in separate buildings, and in locating them according to the strict requirements of the work, and without regard to the necessities of the motive power.

9. Greater facility in the increase of establishments.

10. Localization of accidents due to motive power, with consequent less injury to individuals, and the stoppage of work only at the point where an individual motor is incapacitated.

11. Greater control of the speed of the tools.

12. A marked increase in the product of any given establishment.

Whether to produce or to buy power. — The question whether to buy or to produce power usually brings into comparison the project of erecting a private steam plant with that of purchasing electricity from a public service corporation. Into this question other things than the use of power may enter. If live steam is needed in any process, or if exhaust steam can be used to advantage for heating, it may incline the scales in favor of a private plant. As a pure power problem, however, the general relation between central station prices and private plant costs is determined by a number of factors, prominent among which are the local cost of coal, and the load factors of producer and consumer.

The lower the price of coal the greater the advantage enjoyed by the private plant. The reason for this is that when the cost

of coal is low, the price of power delivered from a central station is strongly influenced by the charges which have to be added for the use of the poles, wires, and meters of the distributive system, and the services of accounting, meter reading, etc. When the cost of coal is high, these distributive and incidental expenses decline relatively, and the fuel item becomes important enough so that the superior efficiency of the large power plant is able to exert a palpable effect upon the price.

The load factor is the ratio of the average load to the maximum load. When the average load of a central power station is low in comparison with its maximum load, the company is apt to offer attractive prices to consumers for electricity to be used at hours other than those of maximum load. If the consuming plant has a low load factor, the cost of producing its own power will be high. The variation of cost with load factor is such that when the average load is but one-half the maximum load (designated as load factor of 50 per cent) the cost of producing power will be 50 per cent greater than when the use of power is uniform. With a load factor of 33.3 per cent, the cost of power will be doubled. The most advantageous condition for buying power exists when the purchaser wants the most power during the hours when the central station has the greatest surplus capacity for sale.

Power and mill design. -- In the days when direct-connected water wheels were the reliance of large manufacturing establishments, mill architecture and yard layout were influenced by the cramped spaces into which factories squeezed themselves along the river banks. Streams of rapid fall commonly have deep beds, and little level ground between the high banks and the water's edge. The narrow sites of the old mills, together with the restrictions imposed upon length by the heavy, slow-moving shafting, made necessary upper stories, and confirmed the first mill type as a narrow, tall structure.

When the production of large fly wheels began to fairly reduce the pulsations of the steam engine, and the Corliss method of

regulating the engine by varying the point of cut-off at last made this source of energy steady enough for spinning and weaving, the manufacturers found their mills liberated from the thraldom of the waterway. The imperfection of belts and the shortness of lines of shafting still kept the shops huddled closely about the power plant, however. With the advent of electric transmission all dynamic connection with the power house is at length severed, and the architect is free to group his departments on new principles of arrangement. Other factors have come to the front, and discussions now turn on construction costs, routing diagrams, fire hazards, and welfare features.

Administration. — The general administrator needs, at least, a broad familiarity with the standards employed in measuring efficiency in power production. He should know whether 14,000 B.T.U. per pound for coal with 35 per cent fixed carbon and 10 per cent ash means a good steam coal or not, whether 10 pounds of water evaporated per pound of coal consumed means good boiler performance or not, and whether 20 pounds of steam per horse-power hour for a simple Corliss engine with condenser is good work or not. He should understand something of coal specifications. It might be useful to him to know the significance of changes in engine-room indicator diagrams. He should exact regular reports of the inspection of shafting and belting, and should expect repairs to be made invariably in advance of breakdowns.

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CHAPTER VII

ADMINISTRATION

Administrative History

The history of the last century of American industry, considered from the point of view of administration, may be divided into three periods; the day of the pioneer, the period of the engineer, and the newly-opened epoch of the administrator.

The pioneer period. — The first period was, for the eastern portion of the United States, a time of mixed farming and petty shop keeping, made significant by the gradual growth of the shops of mechanics into small manufacturing establishments, and enlivened by the dashing seamanship and venturesome foreign trading of the merchant marine. In the West it was the day of the pioneers who waggoned their way to the frontier, built cabins of logs, cut down the timber, split the rails for fences, cleared the fields, surveyed the roads, established local governments, and did all the many kinds of heavy work required to convert the wilderness into a habitation fit for civilized man, and to make simple beginnings in the basic arts and crafts.

Throughout the country there prevailed a condition of individualistic effort. Every man's business was his private affair. Methods were crude, and reputations were local. It was rather good health and native shrewdness which brought success than systematic knowledge or far-reaching policies. As the times were slow moving, they called for patience. As the methods were those of trial and error, they emphasized tenacity of purpose. The economic virtues extolled were self-

reliance and such basic things as industry, economy, and freedom from debt. The representative thinker of this period was Benjamin Franklin, whose terse sentences, put into the mouth of "Poor Richard," expressed the prevailing philosophy of the day. The most widely known sentence of Franklin is, "Honesty is the best policy." Of debt he said, "Think what you do when you run into debt; you give to another power over your liberty."[1] He both practiced and preached frugality and industry. "Take care of the pence, the pounds will take care of themselves." "A small leak will sink a great ship." "It is hard for an empty bag to stand upright." "A shilling spent idly by a fool may be picked up by a wiser person who knows better what to do with it: it is, therefore, not lost." "Diligence is the mother of good luck." "The used key is always bright." "He that lives on hopes will die fasting." "Since thou art not sure of a minute, throw not away an hour." "The way to wealth is as plain as the way to market. It depends chiefly on two words, industry and frugality." Thus was laid what may be called the foundation course of the structure of business policy. Laid with maxims of an emphatically personal system of economics.

The period of the inventors and the engineers. — The second period was inaugurated by the inventors and builders. A small group of colonial inventors, including Fulton, Franklin, Eli Whitney, Samuel Slater, John Stevens, and that universal but neglected genius, Oliver Evans, struggled against the handicaps of crude apparatus, small capital, and defective patent laws. With the coming into prominence of such men as Thomas Blanchard, S. F. B. Morse, and Elias Howe, there began a succession of mechanical geniuses which has been continuous to the present day. To it belongs Peter Cooper, iron manufacturer and builder of the first American locomotive, Geo. H. Corliss, the perfecter of the steam engine, Obed Hussey and Cyrus McCormick, inventors of the reaping machine, James B.

[1] This refers to imprisonment for debt.

Eads, first American builder of iron-clads and great steel bridges and the inventor of the jetty system, Alex. L. Holley, perfecter of water-works machinery, and John Ericsson, inventor of the screw propellor and the hot-air engine and builder of the Monitor. To them, and men like them, it is due that the canals and trunk railways were built, that agricultural implements were devised to handle the immense farm areas of the West, that the colonial iron-working shops grew into factories, that the principal machine-tools were perfected to accurate and semi-automatic operation, and that the principle of interchangeable mechanism was perfected and given to the world.

As the task of bringing physical agencies to the service of industry has reached a certain degree of intricacy, the inventor has been progressively supplemented by the engineer, whose advent means that to the inspiration of native talent there must be added the exact knowledge and certain power derived from systematic training in engineering science. The engineer is the first scientifically trained man to be introduced into industry. He is the first representative of science to come into contact with the autocratic rule of the practical man, and to begin the process of sifting methods derived from tradition with the instrument of controlled experiment. With his coming, and through his influence, there has been set up in industry new standards as to accuracy and completeness of knowledge, new conceptions of natural and economic law, new ideas as to the use of records and standards, and a new practice as to preliminary preparation, standardization, and the close coördination of functioning parts. Admiration for these results has generated a demand that, in another department of industry there should be introduced something which might, by analogy, be called "human engineering."

The Captains of Industry. — While pioneering is not yet entirely over, and while inventing and the applying of engineering control are still important, we have passed into a period characterized by the prominence of questions of a purely admin-

istrative character. Our first general administrators, now so often referred to as the Captains of Industry, had set before them an economic task of perplexing variety. Most of them were obliged to support themselves from an early age. With little schooling, they picked up the rudiments of a general and trade education as they went along. They gathered together the small savings, and then the larger profits, by which their fortunes were consolidated and their economic power as proprietors acquired. As their interests grew, and while under the pressure of current duties, they had to learn by experience the executive's art, and catch such glimpses as they could of the underlying principles of administration upon which that art rests. To do all these things, and do them so well that the solutions could set a new standard was so difficult that few, even of our richly gifted race, achieved notable success. Such a struggle called not only for all-round genius, but for an aggressive temper like that of the knights of the Middle Ages, or the condottieri of the Italian Renaissance. The number of men capable of handling large affairs without conspicuous flaws of policy has been small. If one searches the records of insolvencies and bankruptcies and suits at dissolution, one is able to gain some conception of the toll exacted by the amateur administrator. The wastes have been those of a rude struggle for the survival of the fittest. There has been enough hard work done. Indeed, it may be doubted whether any nation has ever worked harder, more continuously, and even feverishly, than America during the recent past. What has been needed is not harder work, nor longer hours, but effort made more effective through the guidance of general principles and a comprehensive plan.

The modern administrator. — Through the work of previous generations this age comes into the possession of such a vast accumulated wealth, and such powerful agencies of production, that the question of administering these instrumentalities in the interest of human welfare becomes the leading one. As the engineers, or technical executives, learned to control physical

resources by science, it now remains for the administrators, or general executives, to control the human factors in industry in accordance with the fundamental principles of human nature. The reference in one case is to the natural sciences; in the other, it is to the social sciences, supplemented by physiology and psychology. With no less respect for individual efficiency than when Franklin's maxims were coined, modern industry, which unites many persons in joint enterprises and engages them in a highly social process, requires an outfit of social standards. The emphatic words were once independence, and at a later time accuracy; they are now the square deal, liberty, coöperation, courtesy, emulation, discipline, professional pride, and self-expression.

The principles which are required for the future guidance of general administrators will be formulated in part from the study of the successes and shortcomings of our Captains of Industry. The lives of such men as William Morris, Stephen Girard, A. T. Stewart, George Peabody, J. J. Astor, Cornelius Vanderbilt, Jay Cooke, Oakes Ames, and Henry Villard will be examined, as well as of many other men of later date, whose names are now household words. This examination has, indeed, already begun, but in so destructive a spirit as to earn for itself the sobriquet "muck-raking."

Business administration has, however, in part outgrown the limits of private affairs and become a branch of a much broader social art of conducting joint affairs. It may, therefore, look for inspiration in a wider field, and turn with profit to the history of all forms of joint effort. Military strategy will yield to it rules for strenuous efficiency; statesmanship will sketch for it a broad philosophy; diplomacy will impart the secret of attaining harmony.[1] Profitable study may be given to the methods in war of such men as Frederick the Great,

[1] For the further development of the contributions of these subjects to business administration, see the Author's work entitled, The Business Administrator: His Models in War, Statecraft, and Science, N. Y., 1914.

Napoleon, Wellington, Von Clausewitz, Von Moltke, Lee, and Grant. In statesmanship the principles of Machiavelli, Richelieu, Peter the Great, Pitt, Bismarck, Cavour, Washington, and Lincoln will demand consideration. In diplomacy the balance and finish of Sir Philip Sidney, Castiglione, Chesterfield, Metternich, Talleyrand, and Hay will challenge the emulation of the business leader. And so the executive engaged in industrial affairs may be brought into that great company of leaders who, as Goethe says, "By deeds and actions give laws and rules."

The American Setting

There are many reasons why America should now make as important a contribution to the science of management as it made at an earlier period to mechanical progress.

The new environment. — This country enjoys in industry, as in every other department of life, the stimulation of a new environment upon minds trained in old world systems of thought. If the historical sense is little developed with us, and if appreciation of the value of continuity in evolution is lacking, the omission only serves to stimulate decisive thinking by bringing institutions and practices more promptly and unceremoniously into contact with the chief touchstone of value, namely, present utility.

Opportunity. — In America, the great natural regions, with their physical resources, and the many nationalities with their diverse contributions to culture, have made an arena for a large-minded imagination type of industrial leadership. The possibility of viewing accomplishments as the mere beginnings of future empires of industry, and hence as something of mysterious potentiality, has endowed business policies with a dramatic exciting character, which seizes the attention, arouses the faculties and leads men to throw themselves into affairs with an intensity which petty and humdrum conditions could never evoke.

Large-scale operations. — Our extensive domestic market has made possible the organization of businesses on the largest scale. This elaboration has so magnified the agencies employed as to bring into notice matters which, in miniature, would have escaped attention. The factories of 1910 were approximately 50 per cent larger than those of 1900. The average manufacturing institution of 1900 was two and one-half times as large as that of 1870, and five times as large as that of 1850. Many of the establishments now conspicuous for large-scale operations are from 20 to 50 times as large as their predecessors of the periods mentioned. By large-scale operations, the factors determining efficiency are disentangled somewhat as the parts of a complex living tissue are made distinct by the magnification of a microscope. Distributive campaigns have grown so large that details such as the periodicity of a follow-up, or the exact weight of a catalog, have been studied to an extent causing surprise elsewhere. In the accounting of great corporations, the elements of intangible property, which in small affairs remain undefined, are so important as to have called into existence what amounts to a distinct subdivision of the science of valuation. Where a single administrator could rub along by intuition, the widely separated and much specialized officers of a great staff have been obliged to elaborate the rules of action and give them permanent record in books of instruction.

Distinction between capitalist and administrator. — The work of the administrator is beginning to be separate enough from that of the capitalist so that it is possible to perceive that the true art of administration is a thing which is in many ways distinct from the current process of acquiring a private fortune. We have long been familiar with the distinction between labor and capital: the two elements thrust widely apart by the introduction of the factory system. But we have not so clearly seen that this system is separating the administrator from the capitalist. Property right is a slow thing to move, hampered as it is by much definition in books of record, and impeded by the

dead weight of vested interests; but the art of administration is a thing of active change, responding to the forward reaching of natural leaders in the prime of life toward ideals. So long as we have thought of owner-managers, we have confused administration with the economist's "risk-taking," and the business man's "money-making."

The use of the corporate form of business has, however, been rapidly bringing about a distinction between ownership and administration. The American stockholder exercises very little direct influence upon administrative policies. He empowers the directors to represent him; the directors, acting usually through a small executive committee of their members, place matters largely in the hands of the elected officers; these, in turn, delegate again and again down the successive ranks of the administrative line. The result is that we now have, in great businesses, three distinct interests: namely, a body of investors who own the securities, a body of operatives who perform the routine tasks and, standing between these two, a body of administrators.

Professional feeling. — For the present, no doubt, the administrator looks upon himself chiefly as the representative of the investors, and takes the traditional capitalistic attitude. But he is fast awakening to a consciousness of his distinctive function, and is learning to think independently, and formulate standards which are purely administrative. The administrative group finds itself in a pivotal position as the trustee of the property of investors, as the teacher and leader of the operative force, and as a delegate responsible for the preservation of certain public interests. Thus centrally set as an agency of progress, the business administrator, taken at his best, may be confidently recognized as the representative man of action of the age. As such, he is the spiritual descendant of a long line of administrators of former ages, — the tribal leaders, spiritual princes, and knights-at-arms of past time. A new profession, and something more than a new profession, is in our time being

produced. As it emerges there comes forth from sifted and classified experience the first principles of a new science of administration, in the light of which the administrator begins to understand the possibilities of his position. These new principles are welcomed by those who have imagined the ideal and are eager to find the means for its realization. They are welcomed by public opinion, which through multiplied interference with the doings of the superman as a mere money maker, has testified to its anxiety for a new day of more liberal leadership.

Scientific Management

The latest material contribution of a systematic character to the science of management has come, as we should naturally expect, as the result of the work of men of scientific training, whose activities have carried them into business.

Historical. — About the year 1880, a small group of mechanical engineers, attached to certain metal-working establishments in the eastern part of the United States, began to inquire seriously into the causes of the inefficiency of shop operations. These investigators found that the conditions under which work was done had never been brought under sufficiently accurate control to determine whether failure to perform a given task was due to the workman, or to some one of the conditions over which he had no authority. They began a series of experiments looking toward better methods of handling labor; and carried these experiments through persistently for many years, although hampered at times from lack of funds, suspicion of motives, and the complexities of the subject itself. From the first these studies spread out over a variety of subjects, including the mechanics of the machining of metals, the laws of fatigue of human motions, and the equities of the wage system.

Conditions found. — Through these studies it was found —

1. That the conditions involved in determining the efficiency of even the so-called simple forms of work are complex, little

understood, and beyond the power of operatives without scientific education to analyze.

2. That current performance and the method prescribed by craft traditions is crude and wasteful, judged in comparison with what is possible by scientific control.

3. That much of the tools and apparatus used is but indifferently fitted for its purpose.

4. That little is known and less practised with reference to the laws of fatigue, so that the tempo of work, and the sequence and duration of work and rest periods, is set by guess.

5. That workmen are everywhere performing tasks for which they are not fitted and, for the most part, without knowing it, or knowing for what they are fitted.

6. That no one, whether workman or manager, knows the time which the performance of a given piece of work should take, or how much a first-class man should do in a day.

For a period of twenty years this group of men, most of whom were leaders in their profession, worked at available times upon these problems. Their general conclusions were that, in comparison with what is possible with scientific control, the industries of the country are working at about fifty per cent efficiency.[1] In view of the self-satisfaction which at the time of the publication of these reports marked most public utterances concerning American industrial achievements, the independence of this conclusion is striking. It is interesting to observe that these conclusions growing out of the study of shop processes were confirmed within a short time by independent investigations into the national methods of handling natural resources, by studies of the waste of mercantile distribution, by the reports of engineers concerning railroad operations, and by the conclusions of psychologists as to the low plane of efficiency upon which most men are contented to live.

[1] See, Hearings Before the Sp. Com. of the H. of R. on The Taylor and Other Systems of Shop Management, III, pp. 1389 and 1734. See also, Iron Age, Jan. 9, 1913, for results at the Watertown Arsenal.

The new program. — It will be readily understood that if a workman is given a task to perform in a given time, let us say, on a machine, but if the machine is out of repair, or the belts do not convey the necessary power to attain the prescribed machine speeds, or the tools are dull or lost, or the materials are defective, or no foreman is at hand to give necessary instructions, such a workman cannot be held responsible for the failure. The failure is not his; it is a failure of management. To bring under control all these factors, and many others, and isolate the variables representing the workman, the pioneers of scientific management set themselves to organize some new agencies. They recognized that the management was responsible for a wide range of duties which had not been performed; responsible for discovering and prescribing the best method, and for standardizing all conditions.

These many new duties cannot be performed by the customary staff of executives. It is necessary to add new foremen, some of whom will be engaged chiefly in planning how things should be done, while others will be instructors of the operatives. The planning foremen may be grouped in a planning department, or sort of enlarged foreman's office. This office aims to do for shop processes what the drafting room does for matters of design. Some one has said, "The drafting department is the planning room of design; the planning room is the drafting department of production." In such a department the more elaborate studies can be made, and records of performance can be compiled. Good records will "nail down" every advance, so that the improvement of method will not slip away and get lost, and require to be discovered over again, but will serve as a firm basis for the next forward step.

The leaders of scientific management next turned their attention to the carrying out of the orders of the planning room, in the shop. They found as the sole administrative agency of the shop a foreman. This person was heavily overloaded with

duties, and consequently left most matters to be settled by custom and the inclination of the men. It was necessary to materially strengthen this lowest rank in the administrative staff. The new plan is to add enough new foremen so that each man may be put in charge of one phase or aspect of the work. In this way a system called functional foremanizing — a foreman for each distinct group of functions — grew up. A scale of operations sometimes recommended is to appoint four functional foremen, called clerks, to serve as assistant superintendents in the planning room, and four other functional foremen, called bosses, to look after the execution of work in the shops.

The experience accumulated by the executive branch under scientific management is to be communicated to the men by the functional foremen by personal explanations and demonstrations; but there are also provided explicit written instructions for each job, to serve the workmen as reference records and a protection from undeserved censure.

In putting these ideas into practice, it was found necessary to take steps to ensure the hearty coöperation of the workmen. The most important agency in this is a system of wage payments which are just in amount, and which vary in accordance with individual performance. The promoters of scientific management found in use various methods of remuneration, such as the day-wage system, coöperation, profit-sharing, the sliding scale, and the piece-rate system. Among these plans that which pays most nearly according to individual performance is the piece rate. This plan was examined and found to be generally disliked by workmen and opposed by trades unions. The defect of it was found to lie in the fact that rates were set by guess, so that when the workmen were able, by chance, to increase production to an unexpected degree, or when improvements were introduced by the management and had a like result, the rates were cut, with the result that the workmen became convinced that the whole scheme was a trap, intended to reveal

their maximum productive capacity, and then exact the maximum task for ordinary day wages. To remedy these evils, the leaders of scientific management planned a new form of piece rate based upon (*a*), accurate measurement of the amount of work proper to do in a day; (*b*), the guarantee that no rate should be cut or time changed, except as conditions of production changed so that the task became in reality a new one, and (*c*), the full recognition of the fact that an extraordinary day's work required an extraordinary day's pay. The aim, in brief, is to apply science as far as possible in measuring the factors involved in establishing the balance between performance and reward, and to deal squarely, generously, and openly with the laborer, so as to expect and deserve intimate coöperation and the entire banishment of discord.

The creed. — The central ideas of this movement can be summarized in a list of points somewhat as follows:

1. The management must be responsible for all managerial functions.
2. An increased administrative staff must be provided, to perform the wide range of functions connected with planning and the supervision of performance.
3. Planning should be carried on in advance of, and distinct from, performance.
4. A new group of standards should be formulated for the control of the condition of equipment, and the regulation of the time, place, and manner of performance. Standard times involve a schedule of events. A schedule necessitates systematic routing, so that the whereabouts of work may be known at all times. These standards should result, finally, in the assignment to each person daily of a definite and clearly circumscribed task.
5. Select persons who possess special aptitude for the task assigned to them.
6. Individualize records of performance, and furnish prompt information as to results.

7. Remuneration should be in accordance with individual performance.[1]

Secretary W. C. Redfield has thus summarized the points of the present movement: "Disclaiming attachment to any particular system or exponent of efficiency, the following elements may be said to be clear in all that is proposed in behalf of the alleged new industrial gospel:

"Close coöperation and sympathy between the management and the workmen. This is foremost and basic. If it is not realized that this *is* foremost and basic, the subject is completely misapprehended.

"The standardization of equipment and accessories throughout the shop.

"The systematizing of work in operation, of the care, maintenance and issue of materials and tools, and the careful routing of all orders while passing through the works.

"The planning in advance of the work for each machine, and furnishing tools, fixtures, and materials ready to the hand of the workman before needed, so that delays between operations are cut out.

"The study of the actual time occupied by each element or movement of every operation, in order to determine the correct time required for it, and to save waste energy.

"The determination in time study of the proper allowance for rest, necessary delays, or interruptions of work.

"The fixing of standard time for doing work, based upon the aforesaid studies, and the careful personal instruction of workmen in the best and easiest methods of working.

"The payment usually to the workman of a bonus or pre-

[1] Mr. Harrington Emerson has stated the principles of efficiency in twelve points. 1, Definite plans and ideals. 2, Supernal common sense. 3, Competent guidance. 4, Discipline. 5, The fair deal. 6, Despatching. 7, Reliable, immediate, and adequate records. 8, Determination of standards. 9, Standard practice instructions. 10, Standardized conditions. 11, Standardized operations. 12, Efficiency reward.

mium, based upon his doing the work in a certain relation to the standard time."[1]

Influence exerted. — The investigations which we have here briefly considered were carried on quietly, with no further publicity than occasional papers read before professional societies, until the railroad rate hearings in Washington in 1910 brought the system prominently before the public. In those hearings Mr. Louis D. Brandeis, representing eastern shippers, presented the argument that American railways would not need rate increases if they adopted the methods of scientific management. In particular, at this time, an estimate made by Mr. Harrington Emerson that the railroads might save $1,000,000 per day in operating expenses, attracted general attention and aroused lively debate. Since that time many books have been published on the subject of scientific management, numerous conferences have been held, and several national societies have been organized for the study of efficient business methods.

The full program of scientific management, complete in every particular, is nowhere in operation. A moderate number of establishments employ the greater part of the plan. Countless businesses have been aroused by the story of the original experiments, and have felt the influence of certain ideas which form a part of the doctrine. The various essential points of scientific management are by no means all new; some of them are now enjoying a new vitality and definition as the result of new experiments, others are incorporated without change from accounting practice or from the system movement or from non-economic experience.

The advantage of bringing the various elements together in a creed or code is that a logical system is thereby created which has more significance and carrying power than the various points would possess if advanced disconnectedly. With a

[1] The New Industrial Day: A Book for Men who Employ Men, N. Y., 1912, pp. 176–177.

complete program before him, an administrator can select such matters for application as his conditions or his state of mind will permit. It is altogether probable that the chief service which this movement will perform will be through a general process of permeation, by which ideas will pass informally from establishment to establishment; a certain improvement being adopted in one place, a different feature introduced in another place, a new attitude of mind coming to animate a man here and there. If the movement starts anything like a general process of self-examination among manufacturing concerns and other businesses of similar managerial conditions, its leaders may well feel content with their contribution to progress. Scientific management has come into existence at a logical time. It has come, as Mr. Charles B. Going has said, in company with engineering, conservation, fire prevention, factory hygiene, welfare work, cost accounting, and government efficiency.

Objections. — It is natural and proper that objections should be urged against scientific management. Among those which have been offered let us consider a few, aiming in the discussion, chiefly, to further elucidate the system.

1. *Mental stagnation:* It has been urged that since scientific management determines so many matters for the operative, and instructs him so much in detail, it will reduce him to an automaton, and destroy his power to think. In the average shop the method is ordinary: under scientific management it is the best attainable. Is it the superior method which is hostile to thinking? In the ordinary shop men are for the greater part of their time employed on tasks beneath them in quality, while the thought rambles in unproductive wool-gathering; in an efficiency shop the aim is to keep men upon the highest kind of work of which they are capable. Is this concentration of faculties the road to intellectual stagnation? In the average shop there is little instruction from persons of superior knowledge, and the processes drift along at the com-

fortable level of the average mind: under scientific management the operatives are intimately associated with a group of instructors who explain and demonstrate the best methods, as in a training school; and they are furnished with carefully prepared instruction sheets which are virtually the pages of a text-book upon the art in which they are engaged. Surely such a contact between higher and lower is not deadening. Drudgery is work done in darkness of spirit. The remedy for it is to let the light of intelligence shine upon it, by multiplying the means of communication between the world of thought and the world of work. The intelligent man finds a means of robbing even the crudest work of drudgery, for his inner resources enable him to make out of the work a problem of method. For the man who cannot thus save himself there is but one salvation: to bring him and his task into contact with a superior mind, so that his blindness with reference to the possibilities of his task may be cured. In answer to Mr. Mitchell's flourish that, "The worker should not be deprived of his right to think," [1] it can safely be said that more thinking is done in connection with scientific management than any other system of production ever devised, and that a higher ratio of thinkers to mere "hands" is required to operate it than any other. Under scientific management the attention of the workman is sharply drawn to his task. He entertains a new respect for it, by learning that it is a worthy object of study, and that it is possible to bring out of it an unsuspected fine art. Fine methods act as a mental tonic. The tone of shops converted to efficiency methods is raised at once, and the men gain in self-respect.

As to the liberty which the workman enjoys of suggesting better methods, a scientifically managed establishment offers the greatest possible opportunities, for it can most quickly test and reject inferior variants, and most fully reward those who discover superior methods, because its control of opera-

[1] Greater Efficiency, Apr. 1914, p. 30.

tions permits it to make the new method standard and so fully exploit its advantages. When it comes to the recognition of the exceptional talent which appears among workmen by giving promotion, no establishments are so favorably organized as those with functional foremanship, for none have such a large corps of subordinate officers and special foremen to be recruited from the ranks. As is well known, the chief administrative bar, in ordinary establishments, to the making of suggestions by operatives is the general foreman, who is too busy to welcome criticisms from the force, who quickly gains the idea that a thinking workman is trying to make a showing to get his job, and whose uncurbed power over hiring and discharge makes his enmity fatal to an employee. The plan of functional foremanship, by destroying autocratic power, facilitates the upward as well as the downward passage of information. Mr. Leroy Tabor, President of the Tabor Manufacturing Company of Philadelphia has said, "In order to make a man feel that he is perfectly free to make any criticism along any and all lines it is necessary to so arrange it that no foreman can directly discharge him."

Scientific management imposes only one bar to suggestion, and that is the ancient rule recognized in every fine art and applied in every scientifically controlled profession, namely, that no one shall presume to revolutionize methods who has not demonstrated his mastery of the method already in use. The purpose of the rule is to defend the precious body of accepted knowledge from violent hands; and avoid the perpetual uproar as to methods which would ensue if attention were given to every one who pretended to a grasp of fundamental principles.

2. *Oppression:* It has been asserted by a representative of organized labor that, "By scientific management, the employers are trying to squeeze the last drop of blood out of the bodies of the workers." [1] This is simply a question of fact.

[1] Mr. Duffy in Greater Efficiency, Apr. 1914, p. 35.

The three volumes of Congressional investigation of the Taylor and other systems of shop management [1] are a standing proof that the combined efforts of disaffected individuals and hostile unions failed to prove any such thing as this in the case of any establishment operated according to the principles of scientific management. The distinction between scientific management, and a drive management, which may by chance use some scientific agencies, is that drive management secures results by driving operatives to work harder, and does so without proper safeguards against excessive pace; while scientific management secures its results chiefly by extending and energizing the managerial staff, and through it discovering a better way of doing things. The new duties of administration have been classified by Mr. F. W. Taylor as follows: "1, Gathering all the great mass of traditional knowledge and reducing it to laws. 2, Scientific selection and progressive development of the workman. 3, Bringing the science and the scientifically selected and trained workman together. 4, Almost equal division of the actual work of an establishment between the workmen and the management." [2]

Where increased exertion is called for from the operative, scientific management safeguards him by numerous and rather elaborate precautions. There is, indeed, much still to be done by business administrators in protecting workmen from over-strain. This problem will be considered more at length in a later chapter.

3. *Misuse of scientific agencies:* It has been urged that, by discovering new tests of the worker's capacity and new agencies for his control, scientific management is forging weapons which may fall into the possession of harsh and selfish managements,

[1] Hearings before the Special Committee of the House of Representatives on The Taylor and Other Systems of Shop Management, Washington, D. C., 3 Vols., 1912.

[2] Hearings before the Sp. Com. of the H. of R. on The Taylor and Other Systems of Shop Management, Washington, 1912. Vol. III, pp. 1393–1395.

and be used for the oppression of operatives. This is not an argument against scientific management but against the discovery of any scientific instrumentality whatsoever. Effective agencies are, of course, effective in misuse, as in use. The danger of misuse does exist; it exists here as it does at every step in progress which endows the human hand and the human brain with agencies of increased potency. The first answer is that the more refined and scientific the nature of an agency the more its use will be confined to men of education, whose minds are normal and orderly, who have learned to enforce discipline upon their own passions, and who aspire to broad-minded and just ideals. A second answer is that experience shows that, in the application of any new agency, good uses vastly predominate over bad ones. If we believe that the majority of people are fair-minded, as those labor leaders who speak so much of industrial democracy certainly must do, we need have no fear of general results. A third answer is that any system which lays special emphasis upon investigation and scientific agencies of accumulating knowledge is sure, sooner or later, to accumulate records which will reveal the true significance of every health-destroying condition and every policy which breeds the sense of injustice. It may at the start be crude, but it is bound to improve. "Let the light shine," said Erasmus, "and the darkness will disappear of itself." A fourth answer has to do with the choice of methods of influencing industrial evolution. The technical progress of the world's industry has now attained such momentum that it is not likely that any special economic interest can retard it materially. With each increase in the command which society possesses over the agencies of living there is a need of further enlightenment as to the worthy objects of life. What a world which is rapidly growing rich most needs is not those persons who rail against progress but those persons who can vividly picture the attractions of the ideals which the technical advance has at last converted into possibilities.

What shall be the next step in the application of science to management? — Now that the nature of the contribution which scientific management has to offer is reasonably well defined, we may look beyond it and ask what more the application of science to management will involve. When the achievements of the period of the inventors and engineers are considered in comparison with the problems of general administration upon which interest now centers, scientific management appears in the light of a transitional aid or bridge connecting the day which was absorbed in material agencies of production with the present, which is concerned with human relationships. Most of the pioneers of scientific management are men of engineering training. Beginning with circumscribed technical problems of shop operation, they followed the lead of their studies up into the higher world of general administration. They have by no means constructed a complete science of administration. They have, however, contributed some valuable materials to it.

Administrative Principles

In order to present somewhat more fully the problem of the general administrator than was possible in connection with the discussion of scientific management, let us add to the principles there enumerated some others which bear upon the adjustment of the human factors.

1. *The measurement of authority:* Clearly defined relations of authority and responsibility should be established, definitely assigning every function, placing no one in subordination to two others in the same responsibility, and avoiding undue concentration of authority or duty at any point.

2. *Division of functions:* The principle of division of labor applies as much to administration as to execution. In subordinate administrative positions the grouping of functions will aim chiefly at bringing together work of the same nature. In the middle ranks it will aim at including in groups the functions

for which an administrative subdivision, such as a bureau or a department, should be responsible. In the highest positions the chief aim will be to utilize completely the talents of a gifted person.

3. *Choice of persons:* The underlying rule is that talents and functions should be in harmony. But since it is important to make the initial positions in any business as far as possible those positions which are at the bottom of the various lines of promotion, and since the higher ranks can only be kept full through the fitness of those who are below for advancement, it is important that candidates should possess talents not immediately utilizable, but which give the promise of growth. The lower a position is in the scale of advancement, the more essential is all-round talent in the candidate, so that future promotion can take any one of a variety of directions, according to the necessity arising from the balancing of the force. The higher a position is, the more will specific training and special talent decide the choice.

4. *Coördination:* Each agency in an organization, whether that agency be a gang in a shop, or a corps in an office, or a stand of machines adapted to a process, should be brought to such a degree of productive power as to be able to perform as much of its kind of work as the functioning of the other agencies will render necessary.[1] The test of perfect coördination is equivalent marginal utility. The last doses of labor force, executive attention or invested capital applied to the various functions of an enterprise should bring in substantially equivalent profitable returns.

5. *Coöperation:* The power of an organization is the result of its constructive and aggressive forces minus its resisting forces. When the administrator feels himself to be the sole driving agency, and finds himself chiefly engaged in arousing those who are apathetic and coercing those who are antag-

[1] For mention of this principle, and an illustrative diagram see Ch. IV, Layout of a Manufacturing Establishment, pp. 61–62.

onistic, there is something vitally wrong with the plan. An administration should find itself mainly engaged in directing the energies which create themselves naturally in all parts of the business, and in finding the proper outlet for the eager upward striving of the ranks below. An administrator should not be chiefly a whipper-in but a guide; not a detective but a creator of opportunity.

6. *The system of orders:* Affairs are easiest controlled in their origins. The power of initiative belongs to the administration. All performance of a non-administrative character should be in response to orders only. The order, which is primarily a communication of necessary authority, should, under the complex conditions of modern industry, be elaborated to include all necessary instructions as to materials, tools, processes, sequences, and standard times.

7. *The system of reports:* An order communicates authority from a higher to a lower. A report discharges the responsibility of a lower to a higher. Just as an order should communicate all information necessary for execution, so a report should communicate all information essential for administration. The functions of an organization should be so planned that the major part of the information necessary for the executives will come into their hands automatically, through the normal functioning of the business, and not as a result of their personal efforts in collecting it.

8. *Information:* There are three tides of information which should flow swift and straight and full within an organization. The first of these, mentioned in point 6, is the communication of authority and information downward. The order should carry this, but it should do more. It should aim to reveal to the mind of the operative whatever of elegance of means or refinement of art is known in connection with his task, so that something of intellectual significance shall rise out of the work to arouse his interest, and give him ground for self-respect in his accomplishment.

The second stream of information, mentioned in point 7, flows in the reverse direction from operative to executive, giving account of the authority used. A perfunctory report should be a small part of the inpouring of information upon the executive from all directions. There is bound to be a large volume of valuable ideas springing from the experience of those in the ranks, provided men are encouraged to think as they work. It is the function of a suggestion system to gather such ideas by a plan which avoids the opposition of the foremen or fundamentally changes that attitude, which provides a competent board to examine suggestions, and which rewards those who contribute both adequately and in a way to stimulate emulation.

The third movement of information is again from administrator to operative and has for its aim to inform the operative of his individual record, of the record of his department, and of the significance of these records in the achievements of the business as a whole. It is a deeply implanted instinct to desire to know the results of our efforts. A knowledge of results is an important part of the reward of effort. How much interest would there be in a football game if at the end of every quarter the ball were kicked into another field, where the play was continued by another team; and if no one but the athletic association could calculate the score, and no information as to results were given out until the end of the month? Associated production, engaged as it often is in processes which bear but remotely upon completed utilities, expects men to be interested in directing their energies into a void, where they are lost to calculation for a week or month, or perhaps forever, except as remote inferences can be drawn from occasional promotions and discharges.

Mr. W. H. Mallock [1] has explained the work of a leader to consist in constructing out of ideas a sort of go-cart for wheeling along weaker intellects more rapidly than they could go with

[1] Aristocracy and Evolution, N. Y., 1901, p. 137.

their own powers of locomotion. Adequate information sets up a court of reason, banishing the reign of "Do this because I say so," and substituting a government based upon permanently established, public, and impersonal rules of action.

9. *Promotion:* Ambitious men aim to perform their tasks in such an excellent manner as to attract attention, and indicate their fitness for promotion. Wages do not balance the account for such services: a part of the expected reward is advancement. If an administration introduces men from the outside into the higher positions, it gives notice to its employees that promotions need not be expected, so that only so much service is looked for from them as will exactly counterbalance the current wage. But if a business makes a point of advancing its own men, the whole force becomes occupied in making records; and even the loss from the death or resignation of valuable men is partly offset by the stimulus which runs down the promotion lines. Promotions are facilitated by forming positions into a ladder or series of steps, in which the work of each place is a preparation for the next higher place.

10. *The normal incentive:* When men work for themselves they are energized by three types of incentives: first, the pleasure they derive directly from the work itself as an outlet of energy and a demonstration of mastery; second, the consciousness of service, or the realization that the work satisfies the want of others; third, the personal profit arising from the remuneration received. It is a shame for an administration to cut off its employees from two of these incentives, and leave to them only pay as the energizer.

11. *Administration and human nature:* Administration is chiefly a task of handling men. Its methods must conform to human nature. It should educate and interest men, and so conserve the delicate tissues of mind and body from which all human energy proceeds, that disease, premature invalidism, apathy, antagonism, and all other negative and destructive factors shall be reduced to the lowest possible sum. Men

love distinctions, and social rewards; and delight in sharp groupings which evoke the spirit of common cause, and emulations with the game of self-testing strong in them. Their nature is to learn by vivid personal illustrations; and to work in spurts for nearby and tangible rewards. Modern industry is often too prosaic and too mechanical to arouse men. There is need of more badges and distinctions and honorable mentions, for more foremanships and minor executive positions to aspire to, and for more special committees to serve on. The new day in administration will see a way found to introduce into industry more spice and romance, and more exercise for the emotional nature, — more strategic play to capture the interest, and more fine, imaginatively presented aims to awaken real devotion.

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CHAPTER VIII

THE FUNCTIONS OF THE WORKS MANAGER

The supervision of manufacturing processes, and the control of the various service departments whose activities are directed specifically to furthering these processes, devolves upon the highest technical authority in an organization, namely, the general superintendent or works manager. This executive is expected to keep the physical equipment and the productive processes up to standard, and to employ an adequate force of foremen, laborers, and mechanics. He controls operations through a schedule, by means of a system of orders, and through an inspection system which measures the work both as to quantity and quality. He controls the drafting room, the planning room, the tool room, and any scientific laboratories which may be maintained. Let us consider briefly some of these functions of the works manager.

The state of the art. — The duties of the works manager concern themselves with men, materials, equipment, and processes. Men he has to hire, train, assign to positions, superintend, remunerate, and promote or discharge. Materials he must select, test, purchase, store, use, and account for. Equipment he is expected to select or invent, build or buy, preserve and repair, and finally discard as scrap. Processes need devising, testing, introducing, superintendence, enforcement, and revision. Responsibility for "the state of the art" may be used as an expression to cover a wide range of technical duties resting upon the works manager and his administrative helpers.

Motion study. — A new instrumentality has recently been devised for the analysis of the technique of production, called motion study and time study. Motion study has been defined as, "The science of eliminating wastefulness resulting from using unnecessary, ill-directed, and inefficient motions." [1] Its aim is "to find and perpetuate the scheme of least-waste methods of labor." Time study is defined as, "The art of recording, analyzing, and synthesizing the time of the elements of any operation. It differs from the well-known process of timing the complete operation, as for instance, the usual method of timing the athlete, in that the timing of time study is done on the elements of the process."

Motion study aims to eliminate useless motions and save time and energy. It strives to link motions to each other in the most economical sequences, so that the end of one movement is as nearly as may be the starting point for the next. It endeavors to substitute a few effective movements for a multiplicity of ineffectual ones, as when a mason is instructed to lift a packet of twenty-four brick to the wall, instead of laboriously transferring each brick separately. In the measure that motion study succeeds in achieving its aim it discovers the best method, and prepares the way for a standardization of processes and equipment such as will permit permanent time studies to be taken. The time studies in turn will make possible the determination of standard times upon the basis of which employees may be judged and rewarded.

Standardization. — The original conception of a standard is of something standing, permanent, and stable. From this comes the idea that what is fixed may be used as a signal or mark or point of reference, like a royal standard in battle, about which many can rally, or after which they can follow. When King Henry fought in Normandy in 1109, he caused his

[1] Frank B. Gilbreth, Primer of Scientific Management, N. Y., 1912, p. 8. An illustration of the application of motion study was given in Chapter I, in the account of the revolution of the art of bricklaying.

standard-bearers to take a position on ground favorable for defense, so that his men might rally about it. In 1120, when he decreed that the ell, or ancient yard, should be the exact length of his arm, he set up another kind of standard (the first definite one of length in England), about which his subjects might rally in the buying and selling of property. The word may signify that which is prescribed, or that which ought to be prescribed; in all cases the idea of uniformity imposed by authority is strong in it. Standards are by no means limited to the measurement of the physical properties of materials. They may be established for anything that is measurable. If it is ordered that the air in working apartments shall be changed three times per hour, a standard is set up; if it is ordered that there shall be no belt failures, a standard of efficiency in preliminary repairs is established; if a given time is allowed for a piece of work, a standard of speed is involved.

The process of standardization is the attainment of such an intimate and thorough administrative control that every case of performance conforms to the rule laid down. When performance depends upon a variety of factors, standardization means the control of all the factors. When one factor is brought under control, the circumstances which cause the variation of the other factors are more easily studied. Each step facilitates the next. Mr. F. W. Taylor has said, "Complete standardization of all details and methods is not only desirable, but absolutely indispensable as a preliminary to specifying the time in which each operation shall be done."[1] Standardization means uniformity. Ideal standardization, or standardization used as an instrument of efficiency, means uniformity in using the best. This element of uniformity facilitates mutual understanding, and by determining what is to happen makes possible preliminary preparation.

Written orders. — Standards are authorized by standing orders or general orders. An order, as we have seen, is the

[1] Shop Management, Am. Soc. of Mech. Eng., Paper 1003, Sec. 284.

communication of authority and information from a superior to a subordinate. In a small business, where the close personal touch makes easy a mutual process of adjustment, it is allowable to give orders by word of mouth; but in large organizations, where executives are called upon to give more orders than they can hold in memory, or where the number of points involved in individual orders may overtax the retentive powers of operatives, or where efficiency depends upon the exact adjustment of men to each other who are not in personal contact, orders should be written. A permanent objective record is advisable where considerable periods of time may elapse between the giving of the instructions and the completion of the task, or where instructions must be transmitted through a number of persons. In a large establishment an order may pass through as many vicissitudes as a contract between independent concerns: like precautions ought, therefore, to be taken in its preparation, transmission, and recording. Written records are a safeguard against the thoughtless giving of orders. They recall the official to a realization of the importance of what he is doing, by suggesting to him that the record may be examined by his superiors. They lead, therefore, to fewer orders, and orders of better quality. A written order serves the operative while he is performing his task as a means of reference. Later it offers indisputable evidence as to what he was told to do, and so protects him against unjust censure.

Orders as text-books. — An order does not successfully convey authority so long as the one who receives it cannot ascertain from it what to do in every particular which involves the exercise of the discretion proper to the superior officer. The act of communicating authority shades off by imperceptible degrees into the communication of information. A subordinate is never so open to instruction as when receiving orders: strategy suggests that a full meeting of minds should take place at this critical moment. Furthermore, the rule of preliminary preparation requires that difficulties should be fore-

stalled by explicit original instructions, rather than remedied by supplementary orders.

Orders and scientific management. — The effort to utilize more science in the shop, to foresee difficulties, and to hold the administration responsible for a wide range of new functions, has naturally involved an elaboration of the order. A great step was taken, years ago, in engineering establishments, when drafting rooms began to send down blue prints to the shops, as a means of controlling the dimensions of work. Scientific management aims to extend this idea and establish administrative control of the times, methods, and equipments used in the shop, by means of orders issued from the planning room.

A complete order in a well managed establishment is quite an elaborate affair. In an engineering establishment it includes, among other things, necessary drawings, descriptions of the work to be done and the methods to be used, lists of materials, tools, attachments, jigs, and gauges, the sequence of operations, the list of elementary minimum times, the standard or prescribed time, and the wage rate. It is no slight task to provide a set of modern standard orders. In performing this task there is no useless work done, however, for there is no point decided which will not inevitably arise for decision during the progress of production. To use standard orders means simply to appoint capable men to decide matters once for all, in advance, and under favorable conditions, rather than allow these matters to drift until they are encountered in the progress of work, so that production stops while the workman ponders and experiments, or rummages for lost tools, or travels to the stock room, or hunts his boss.

Analysis of customer's contracts. — When a purchase order is received at a works manufacturing such an article as standard print cloth, it is not necessary for the operative departments to give it attention. The mill is kept going on one thing the year 'round: upon the selling department rests the duty of disposing of the product and avoiding stoppages. The situa-

tion is quite different when a customer's order arrives at a machine shop which does not fill orders from stock. In this case the new contract at once raises the question of possible delivery dates, considering the amount of work which is ahead of it in the shop, and the urgency of the case. A survey of necessary materials must be made to ascertain which are on hand, and which must be ordered. Special drawings may be needed, and new shop orders may have to be prepared. If a number of parts are to meet in an assembly, it will be necessary to start work on some of them earlier than on others. For these and other reasons the selling department should consult with the making departments in accepting any contracts which call for special plans or for a departure from regular schedules.

Schedules. — In recent years, manufacturers have taken a leaf from the book of railway administrators, in controlling the order of events. A railway arranges a schedule of its trains, and the despatcher administers it with a view to keeping the rolling stock of the road in motion. The jobs passing through a shop may be likened to a series of trains passing over a line of railway. The only way by which a continuous advance can be assured, and men and machines can be kept at work, under even pressure, is to lay out a route, establish a schedule and despatch work from job to job.

To attempt a schedule is to bring up the question of the time operations should consume, and to focus attention upon the causes of delay. To achieve a schedule is to make it possible for a management to know the per cent completed on any job, to fix a probable delivery date, to regulate the advance of the component parts of a product so that they will make a simultaneous appearance in the assembly room, and to obtain such a power of directing machines and men from one task to another, that adjustments can be made for rush jobs or unexpected occurrences without confusion. An illustration of the effect of introducing a carefully planned schedule (other condi-

tions remaining unchanged) is afforded by the experience of the New York Navy Yard in removing two twelve-inch guns from the turrets of the U.S.S. *Connecticut* and replacing them by two new guns. This job, which would ordinarily have taken thirty days, was finished in ten days, by carefully planning each move in advance.

Current methods of foremanizing. — The final touch between administration and men is maintained through the foremen. In ordinary practice there is but one foreman to a shop. This man is expected to look after tools and machines, find materials and supplies for his men, instruct them in the manner of doing work, arrange tasks so that every one is kept busy, enforce a proper pace, write up the job cards and other records, preserve order, make reports as requested concerning the progress of individual jobs, inspect work for quality, lend a hand in repairs, suggest improvements in equipment, and give an opinion on which to base promotions and discharges. This is a tremendous range of functions, and it is not surprising that many responsibilities of an administrative character slip from the overloaded shoulders of the foreman, and fall upon the workman. Hence the general demand for "experienced" workmen; a demand which means that men are wanted who can take care of themselves and not bother the foreman. In the one-foreman shop practice remains at a low level, while yet there is demanded excess capacity in the men, above what is needed for craft work alone, to enable them to perform administrative functions. When responsibilities of a discretionary character, concerning processes and equipment, are thrust upon craftsmen in this shiftless way, they rest upon persons not trained for them, not adequately clothed with authority, without effective leisure from manual operations, and without the stimulus of a prospect of an administrative career.

The administrative relations for a single shop, in an ordinary establishment, are illustrated by chart number 27. In such a shop it is obvious that all the information and assistance which

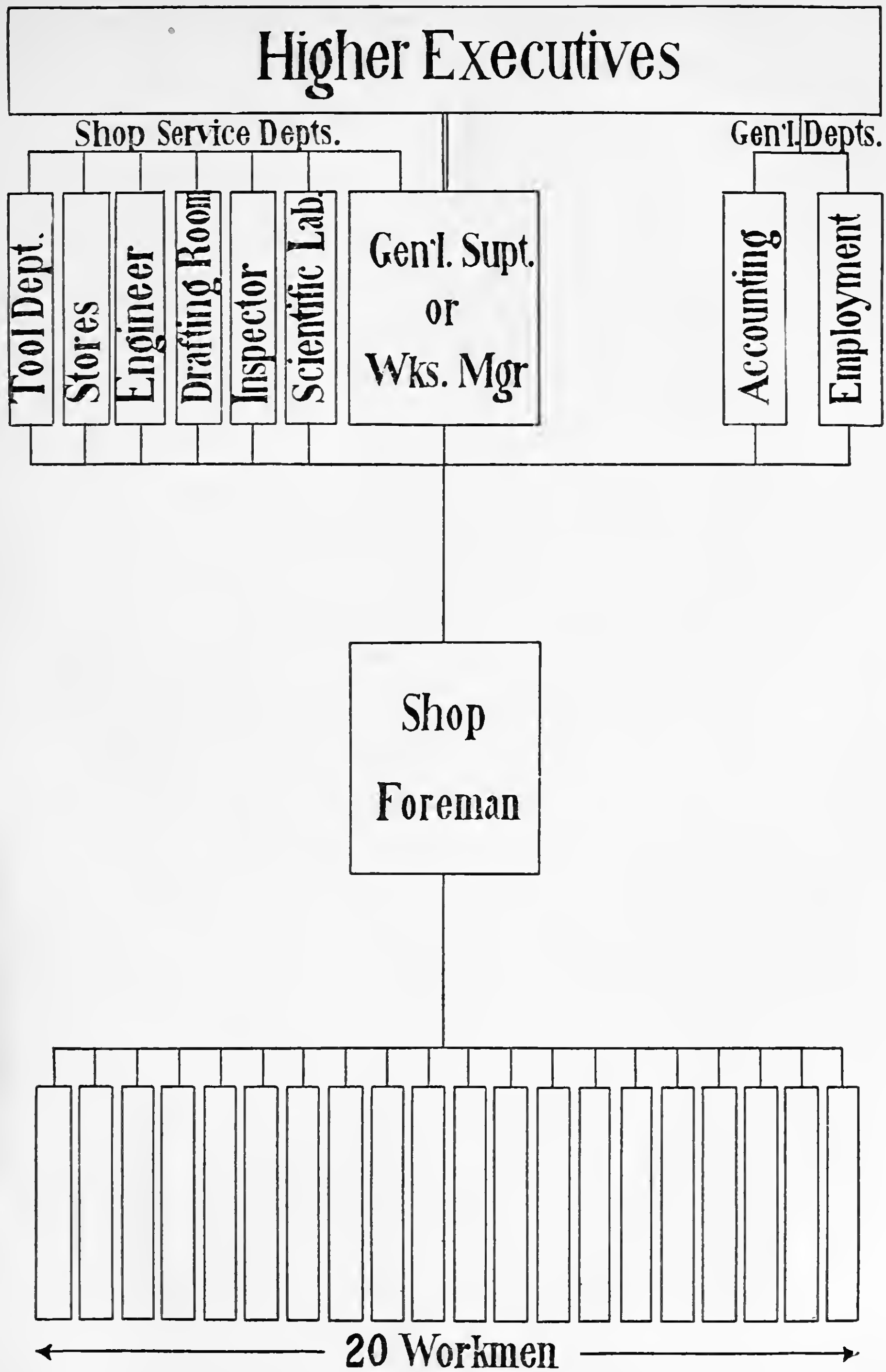

Fig. 27. Chart of Authority for a Shop Under Ordinary Conditions of Foremanizing

the higher executives, the general departments, the general manager, and the service departments can render to the workmen must pass through one channel — the single foreman. If there are twenty executives above the foreman, and twenty operatives under him, one mind is called upon to serve as the intellectual connection for four hundred possible personal relationships between superior and subordinate. It is obvious that we have here an administrative blockade. Here is a weak link in the chain of authority connecting higher with lower. Scientific management has put its finger upon this weak spot.

Functional foremanship. — The remedy prescribed is to open new means of communciation between the staff on the one hand and the operatives on the other, by multiplying the number of foremen, and by differentiating their duties in such a manner that each may be a specialist. This is functional foremanizing: a foreman for each group of functions. It is the application to the foreman of the same ideas of specialization and division of labor as scientific progress has introduced among experts, and as the subdivision of trades has brought about among workmen. A particular plan of functionalizing, recommended by the leaders of scientific management for cases where circumstances permit a reasonably complete development of the idea, is to install eight foremen; four to serve as clerks in a planning room, and four to serve as bosses in the shop. The four clerks may be thus described:

1. The Routing or Order of Work Clerk, who determines the order of jobs at each machine or production center.

2. The Instruction Card Clerk, who prepares the shop orders, including the standard instructions, the lists of materials, the standard times, etc.

3. The Cost and Time Clerk, who sees that all time and material used is correctly reported according to the job, workman, and shop, so that correct payroll and other cost records can be made.

4. The Shop Disciplinarian, who keeps the personal records on which promotions and discharges are based.

There are four bosses —

5. The Machine-speed Boss, who sees that the machine speeds indicated on the instruction cards can be and are attained or are reported back for correction. This officer does not speed up the men, except incidentally in getting the prescribed performance out of mechanically impelled apparatus. He must be able to convince a doubting workman that a machine can be safely operated as prescribed, by turning to and doing the job himself.

6. The Inspector, charged with maintaining the quality of the output.

7. The Repair Boss, who is the engineer in charge of repairs.

8. The Teacher, sometimes called the Gang Boss, who is the old foreman relieved of many duties, and developed into a specialist. His duty is to see that the men are provided with jobs, have the necessary equipment, understand instructions, and manipulate their work properly.

This plan of foremanizing is represented in graphic form in chart number 28.

A new yeomanry. — The project to greatly increase the number of shop executives has a significance aside from the increased efficiency which is the primary aim. If such a new middle class is formed between the capitalistic and artisan classes, it means that there will be a host of interpreters of the management to the workmen, and of the workmen to the management, so that each side will understand the other better. Such a body of foremen should develop a notable power of opinion. They may prove to be such a social cement as to entitle them to be considered a new yeomanry, taking the place of the diminishing yeomanry of small independent proprietors. The existence of a large class of subordinate administrators who must be familiar with shop processes, will greatly

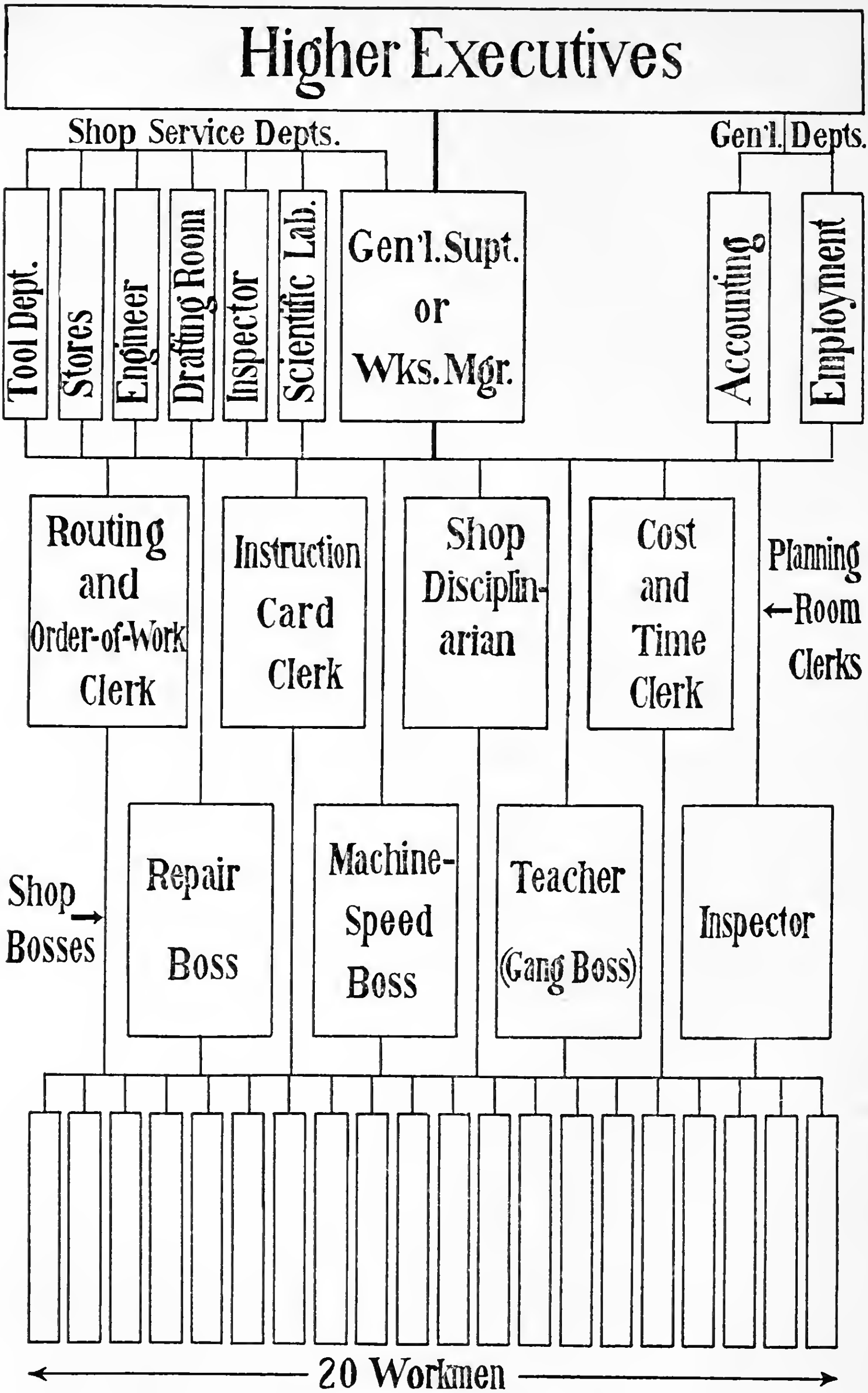

Fig. 28. Chart of Authority for a Shop under Functional Foremanship

increase the opportunities of promotion for exceptional workmen. The functions of such men will serve as a training school in the managerial art, giving promise that chief executives may continue to rise from the ranks, as in the past; giving promise, also, that labor organizations may at length be officered by men who have an adequate knowledge of costs, of capital risks, and of managerial difficulties.

Theoretical and practical considerations in designing. — It is not difficult to find graduates of engineering schools who can make designs which conform to the laws of stress and resistance, or which are, as the phrase goes, theoretically correct. It is difficult, however, to find men for designing departments who combine with this capacity a knowledge of manufacturing processes and of the trials and tribulations of the user.

Good design. — Practical designs in machinery avoid difficult problems in moulding, and shun filets of compound curves for machined surfaces. They reduce highly finished surfaces to a minimum, employ standard sizes of bolts, screws, and gears, and prescribe wcrk which can be turned out with standard arbors, bores, and tapers. A practical designer gives broad bearings at important points, provides easy adjustments to compensate for wear, equips feed screws with index dials, carefully plans the lubrication system, and in general aims at simplicity with positive action and few parts. In designing machine tools he makes detachable tool rests and attachments, so that preparations can be made off the machine. Control levers are so placed that there will be a minimum of reaching and bending for the workman. Dangerous parts are housed, and delicate ones protected, and yet accessibility is preserved for lubrication, adjustment, and repair.

The significance of the test given to a design by manufacturing it and using it is well brought out by Mr. Chas. L. Griffin. A successful design, he says, cannot be out of harmony with the organized methods of production. Hence in the art of machine design is involved a knowledge of the operations in

all the departments of a manufacturing plant. The theoretical design must be so clothed and shaped that its production may be cheap, involving simple and efficient processes of manufacture. It must be judged by the latest shop methods for exact and maximum output. A machine may be correct in the theory of its motions; it may be correct in the theoretical proportions of its parts; it may even be correct in its operations for the time being; and yet its complication, its misdirected and wasteful effort, its lack of adjustment, its expensive and irregular construction, its lack of compactness, its inadequate supply of oil for the moving parts, its difficulty of ready repair, its inability to hold its own in competition — any of these may throw the balance to the side of failure.

"Every detail of the successful machine has been picked from a score or more of possible ideas. One by one, ideas have been worked out, laid aside, and others taken up. Little by little, the special fitness of certain devices has become established, but only by patient, careful consideration of others which at first seemed equally good. Every line and corner and surface of each piece, however small that piece may be, has been through the refining process of theoretical, practical, and commercial design. Every piece has been followed in the mind's eye of its designer from the crude material of which it is made, through the various processes of finishing, to its final location in the completed machine." [1]

The correlation of designing and manufacturing. — How can the production of good designs be ensured? One thing which will help is to provide for the designer convenient lists of the machines, tools, and attachments in the shop, and to prepare enumerations and diagrams of the various styles of work which can be produced in regular course. Shop conferences should be held to bring designers and men of shop experience together. It should be the rule to refer all points of design which involve the purchase of new equipment to an authority

[1] Chas. L. Griffin, Machine Design, Chicago, 1908, pp. 3–4.

higher than the designer before the drawings and specifications are finally approved. Designers should be required to follow personally, in the shop, the progress of manufacture of their experimental models.

Design tested by use. — Use is the supreme test. The consumer sorrowfully gathers much wisdom. Designers should not only study their productions in experimental operation, and continue tests to failure, but should study their products away from the plant, in actual use, in the consumer's hands. They should gather up discarded and worn out specimens to ascertain what ended the useful life, and find out why the design fell short of the coördination of "the wonderful one-horse chaise."

Standards of accuracy. — Upon the general superintendent rests the responsibility of maintaining such standards of accuracy as will preserve intact the qualities aimed at in the original design of his product, and will permit easy assembling, and allow of interchangeability of parts. This involves especially the control of such matters as clearance, allowance, and tolerance. Clearance is a quality of dimensions by which two adjacent surfaces stand clear of each other. Allowance is a difference in the dimensions prescribed for two parts to produce a certain quality of fit. Tolerance is a departure from dimensions permitted as an unavoidable or unimportant imperfection in workmanship.

Tolerance dimensions. — The control of all dimensions which involve allowance or tolerance should be taken out of the hands of foremen and mechanics and concentrated in the hands of the superintendent and designer. This can be done either by placing upon the drawings a single figure for each dimension, with the addition of the plus or minus departures from it which will be allowed, or by giving two dimensions which are to be the outside ones tolerated. By indicating a large tolerance for unimportant dimensions, and a less one for more particular parts, the time and skill of the shops may be

concentrated by the administration upon those parts of the work where they will count for the most.

Measurement of output. — If it is desired to collect a system of unit costs, or to pay men on the basis of performance, ways must be found of measuring the work done. To do this presents no special problem where a good division of labor exists and conditions are standardized. But where there is variety of task and condition, as in the construction trades, the choice of measure and the administration of it is not easy. For painting and plastering and shingling the square yard may be used to state amounts, but it will mean little unless the quality of the work is determined. In concrete work the cubic contents of a structure can be measured, but such a record will merely summarize the result of handling materials, building and erecting frames, removing forms, placing reënforcing steel, tending the mixer, moving, pouring, and ramming the liquid concrete, and finishing exposed surfaces. "In engineering construction," Gillette and Dana tell us, "the cubic yard is a very common unit upon which contract prices are based, but the cubic yard itself is frequently a very uncertain unit of performance, for it is a composite of other units. Thus, in rock excavation there are several distinct operations involved, which may be enumerated as follows; 1, drilling; 2, charging and firing (or blasting); 3, breaking large chunks to suitable sizes; 4, loading into cars, carts, skips, or the like; 5, transporting; 6, dumping."[1] The aim should be to measure elements rather than composites: in mathematical phrase, to measure variables rather than their functions. Hence the measurements sought should be, as far as possible, of elementary performances or single steps of manufacture, rather than of chains of operations. The work of single persons or gangs or of distinct classes of persons should be chosen rather than that of groups of persons pursuing unlike crafts. Thus, in concrete

[1] H. P. Gillette and R. T. Dana, Cost Keeping and Management Engineering, N. Y., 1909, p. 50.

work, measures may be taken of the loads of sand brought up, the bags of cement mixed, the board feet of framing constructed, the number of standardized and individually keyed forms set up or taken down, the square yards surfaced, etc. In rock excavation account may be taken of the lineal feet of holes drilled, the number of charges exploded, the tons or yards of rock broken up, the amounts of material loaded, unloaded, and carried given distances by given means of transportation.

Inspection. — Among the objects to be attained by a system of inspection of products are, to detect poor materials, to discover defective processes or inadequate apparatus, to sift and educate workmen, to save labor, as in the hand fitting of machine parts at assembly, or the improvement of textile fabrics woven with defective yarns, to avoid the continuation of work on material already spoiled, to ascertain the loss allowance necessary in cost estimates, and to escape loss of prestige from the delivery of defective goods to customers. Inspection is, therefore, a check of very broad utility. The chief problem of it is to so analyze and record discovered defects and their causes that an account can be opened with each man, and machine, and batch of material, and operation, and department, so that the inferences drawn may be specific and lead to specific reforms.

The closeness of inspection will be proportionate to the losses which undetected defects may cause. It will be greatest where life and limb are involved, as in the case of signal oil and steel rails. Whether it should be terminal inspection or intermediate between processes, will depend upon the probability that additional work will be done on defective pieces, and upon the danger of defective work being covered up by subsequent steps of manufacture. The process of inspection may be automatic, voluntary, or professional. Automatic inspection occurs where a jig or fixture is made in such a way that work will not fit into it unless the previous steps of manufacture have been correct. Voluntary inspection occurs when men are paid according to the amount of perfect work finished by them, and hence such

workman become critical of pieces which will be counted out, and of materials likely to cause them delay. Professional inspection is a function of administration. It tends to pass into the hands of specialists in the measure that defects are subtle or their causes are difficult to trace.

The tool room. — The immediate material agency in manufacturing is the point of the tool. The problems of labor and management largely concentrate upon the task of bringing a succession of small cutting, grinding, or hammering surfaces into contact with materials, under given conditions as to stress, angle, temperature, and the like. A bench worker depends for the amount and quality of his day's work upon the sharpness of a few inches of cutting edge on his chisels. A ditch digger may waste ten per cent of his energy by forcing an extra eighth of an inch of pick point into the clay. So important to any establishment is the condition of a few pounds of steel on the points of the tools that efficiency demands that the design of tools, the matter of an adequate supply, the sharpening and repairing of them, and their accessibility, should be taken out of the hands of workmen and general foremen and concentrated in the hands of specialists who can apply system and science to the tasks.

A tool room may be described as a department where tools, attachments, and instruments of precision are selected, designed, manufactured, stored, inspected, sharpened, reforged, issued on authority, and accounted for. By being a conspicuous instance of a place for everything and everything in its place, it saves time in getting equipment promptly into its work.

Machine stripping. — The time-consuming practice of machine stripping which goes on in ordinary shops has been thus described by Lieut.-Col. Wheeler of the Ordnance Department of the U.S.A. "In the usual shop, with some machines lying idle, if a man at a machine wants a dog or a bolt or a clamp, the easiest way for him to get it is to go to the nearest idle machine and help himself; and this is what he usually does,

except that he usually takes two, if available, and stows one away near his machine for possible future use. When the idle machine is wanted, much time is lost in supplying it with the necessary equipment. Again, a new man is taken on and put at one of the idle machines and given a job; he does not know the shop and he hunts around for the necessary equipment, and after losing considerable time goes to the foreman, who will send him to the tool room, where he will probably be told that the appliance is with the machine. And he goes from one man to another, trying to get the necessary equipment. After finally succeeding in starting on his work, he finds something else missing, and he has to go through the same thing again, and so on until he learns to go to the nearest idle machine and see what he can pick up." [1] In such a shop each workman will possess a miscellaneous assortment of cutting tools, and will have individual fancies and secrets as to angles and sizes. Much time will be spent by the workman in hunting for misplaced tools, and in examining them and experimenting with them, and in grinding, or waiting at the emery wheel, during all of which his machine stands idle. The tools will be used in all degrees of dulness, and in all varieties of shape. From lack of standardized conditions standard times will be impossible.

Tool accounting. — A proper system provides each workman with a machine kit, including micrometers, straps, bolts, files, etc., but not cutting tools. The workman signs for the kit, and it remains permanently with his machine. Cutting tools will be ground by an expert, to standard shapes, as indicated by the science of metal cutting. The proper tool for each kind of work will be specified in the standard instructions. A complete outfit of tools in perfect condition will be issued by the tool room to the workman each time the job is assigned. On the completion of a job, the cutting tools used, together

[1] Hearings before the Sp. Com. of the H. of R. on The Taylor and Other Systems of Shop Management, Washington, 1912, Vol. I, p. 113.

with any special jigs and fixtures, will be returned to the tool room, to be examined and put in condition before being issued again.

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CHAPTER IX

COST ACCOUNTING

If we picture to ourselves a typical manufacturing plant engaged in producing a variety of articles, and if we attempt to enumerate in our minds the various expenditures which will be made in the process of manufacture, we shall not be long in observing that these expenditures divide themselves into three main groups. The first of them includes the materials of which the product is composed, the second comprises the labor directly applied to these materials. The third group is composed of all those remaining items of outlay which do not attach themselves in a direct and definite way to the production of any individual unit of output. The first and second classes of expenditure are easily computed; when combined they form what is called prime cost. The third group is known as factory burden, or overhead, or simply as "expense."

In a machine-building establishment, these three elements of costs are approximately equal in amount. And if to them we add interest on the capital invested — an item which is, properly speaking, a profit, but which for certain purposes it is convenient to handle as a cost — we should have four approximately equal subdivisions of outlay.[1] In cotton spinning the cost of direct materials is nearly twice the direct labor cost: factory burden nearly equals direct labor: interest charge is a little more than one-half the direct labor cost. In the boot and shoe industry direct materials will average somewhat over two

[1] James Hartness, Human Factors in Works Management, N. Y., 1912, pp. 155–156.

and one-half times direct labor, while factory burden will average a little less than seven-eighths of direct labor, and interest will be not much over one-sixth of direct labor cost. In petroleum refining a typical cost calculated by the Bureau of Corporations showed direct material four times direct labor, and factory burden less than one-half of direct labor. A fair interest charge would be over one-third of direct labor cost.

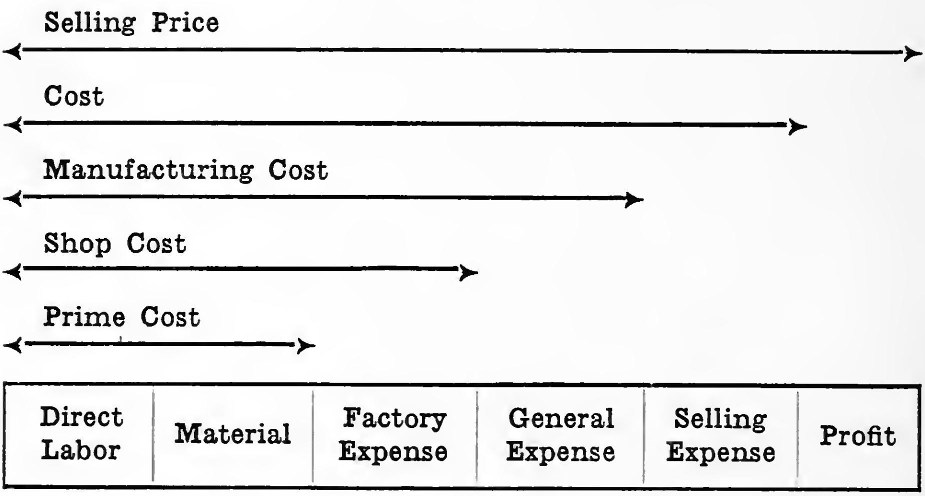

Fig. 29. Analysis of Selling Price

The general relations of different classes of costs to each other may be illustrated by a diagram which separates the component parts of selling price.

Direct material cost. — The most tangible and specific beginning of cost is when raw materials are purchased, out of which a finished product is to be made. When materials are used exclusively for a particular job — a job being a series of productive steps ending in the completion of a unit or lot of product — and when it is easy to measure the amount of the material used in connection with each job, the cost of such materials may be charged directly as direct material cost. The original cost may be interpreted either as the actual purchase price, or the last price, or the average price. Into the laid-

down cost there enter other items, such as freight, cartage, and the expenses of receiving, storing, and issuing. These items will be difficult to subdivide onto each batch of materials requisitioned for a job, and so will be most practically handled as a part of expense.

When we turn to such materials as coal, machine oil, belting, polishing substances, and the like, we find that if we attempt to calculate the amounts used on individual jobs and fix the costs of such amounts, we shall be engaged in a hair-splitting operation. The practical course is, therefore, to throw these sums into expense. As Mr. H. A. Evans says, "Like direct labor there is some material that enters into the product that cannot be charged as direct material, but must be charged indirectly: glue used in a joiner shop or pattern shop; a few nails or screws used on a repair job; a small amount of solder on sheet-metal work; a few cotter pins on a job in the machine shop; the red lead or litharge used in making joints; the material used with the oxy-acetylene welding plant, and many other similar items. On account of the difficulty of measuring the quantity used of some of this material and the small amounts used of other classes, it is impracticable to charge these direct, and they must be included in the indirect charges." [1]

Direct labor cost. — Turning to the labor used to make a salable product, we find no difficulty in charging directly the wages of those persons who deal immediately and exclusively with the work of a single job, and are engaged for a considerable interval of time upon each job. The expenses of the men at the benches, or in control of the machines, or at work on the erecting floor, can be disposed of easily. But when we consider the expense of truckers and crane handlers and foundry helpers, who pass rapidly from job to job, spending perhaps a few minutes on each task, we perceive that it would be impractical to dissect the time of such men into minute fragments for charging

[1] H. A. Evans, Cost Keeping and Scientific Management, N. Y., 1911, p. 27.

purposes; and so these items pass over into expense. Because of a somewhat different trouble in dissection, the wages and salaries of foremen and superintendents, of the office force, and of the general manager, and of all others whose activities serve the interests of many jobs concurrently, must be carried to expense.

Labor as a cost. — There is little difficulty in getting the total labor time or labor cost of any man or of any shop, for the attendance record taken together with the wage rates will yield it. But resistance is often encountered in getting the labor time or wage cost of each job, because workmen object to making a highly detailed record, fearing that the management will use the statistics for censure or for a speeding-up process.

Human beings are a cost, but more than a cost. While the purely material elements of cost respond in a passive and mechanical way to any cost system which may be employed in the interest of economy and efficiency, when system is applied to labor, an independent power of will must be reckoned with. Here the science of accounting becomes a part of a greater art of handling human nature. To one method of cost collecting operatives may respond with indifference or generosity, to another plan which in its accounting significance may not be materially different, they may reply with the bitter resistance of obstructive tactics. It is not safe for an administrator to long regard labor purely from the standpoint of cost.

Expense items. — We now come to the category of "expense," of which something has already been said. We have noted that expense includes —

(*a*) manufacturing supplies, such as coal, machine oil, and belting,

(*b*) incoming freight charges, and the expenses of supply departments,

(*c*) wages of the service force, such as truckers, crane handlers, and foundry helpers,

(*d*) wages and salaries of foremen, superintendents, office force, and general administrators.

To these items we may add others —

(*e*) the expenses of equipment, including all current charges on account of providing and maintaining buildings, machinery, and power plant,

(*f*) the cost of service departments, such as the tool department, the drafting room, the planning room, the accounting department, the employment department, and the legal department,

(*g*) selling expenses, including the advertising appropriation, and the expenses of administering credits and collections.

Underestimation of expense. — The above list indicates that expense is an exceedingly heterogeneous group. It is easy to overlook some of the things which should be put into it. There are items belonging to it which are without tangible reminders at the plant, such as the cost of legal advice. There are expenses which only mature in the future, so that current charging means a calculation from past experience; such as the allowance for bad debts. Materials are visible to the naked eye; laborers troop in and out for their pay; but for the complete enumeration of expense items, cost accounting requires the aid of the comprehensive surveys of proprietorship accounting.

Expense items as functions. — Some of the items of expense are pure functions of time, like taxes, rent, insurance, obsolescence, and a portion of depreciation. These outlays are incurred as a result of the mere existence of a business, regardless of whether the production of a period is large or small, or indeed whether the establishment be running or closed down. Other expense items, such as those for power, supplies, and salaries, will rise and fall with the activity of the business, though not in strict proportion to it.

Grouping of expense items. — Expense items may be grouped for spreading purposes with either of two objects fore-

most. The aim may be to put such items together as tend to rise and fall in response to the same law of variation, so that the law may be used as the principle of spreading. On the other hand, the grouping of items may have for its object to bring together all the costs for which some officer is responsible, so that the question of his efficiency may be brought home to him with clearness. Either of these principles of grouping calls for the separation of manufacturing expenses from selling expenses. If to direct cost, which is composed of direct material and direct labor, we add all the expense or burden which belongs to the factory or manufacturing end of a business, there will be produced a figure representing manufacturing cost. By this figure the general superintendent or works manager may be judged. In like manner, if all selling expenses are collected separately, there will be provided a basis for judging the efficiency of the sales manager.

Systems of spreading expense. — The items of cost for direct material and direct labor are somewhat difficult to collect, because accuracy of reporting is required of a large number of persons: but once collected they may be distributed with ease upon the proper jobs. The items of expense, on the other hand, are easy to collect, but their distribution involves questions of theory so complicated that, for the most part, they must be solved by arbitrary methods. If a business is of a very uniform nature, like a water-works, or a gas-works, or a blast furnace, or a brick yard, or a mill for the manufacture of flour or cement or paper, the various items of cost will tend to rise and fall together. Under such conditions it will not matter greatly what method of spreading is used, for any method will be, in reality, but a division of costs rather than a distribution of them. But when the different items of cost follow different laws of variation, the manner in which they are grouped and prorated with reference to each other becomes important.

Mr. Going tells us, "One underlying idea appears in all methods of expense distribution or apportionment that are commonly

employed. It is this: expense does not naturally connect itself with individual jobs or individual units of product. It gathers like one general cloud over the whole business, but not in distinct wreaths around each transaction. Material and direct labor, however, do, from the beginning, identify themselves with individual operations or individual units of product. You can almost see each job, as it goes through, attach to itself successive items of material and of work. You can see each man and each machine putting material and work together, in visible and measurable quantities, until each piece of product is completed. Now, the underlying idea of all methods of expense distribution or apportionment is to use some one or more of these visible, tangible, and measurable elements as a gauge, and to prorate the expense allotment by it. That is, they burden each job or each unit of product in proportion to the material that goes into it, or the wages paid for it, or the time spent working on it, or the use it makes of the machines and other facilities in the factory. This gives us five cardinal methods of expense distribution: by material, by percentage on wages, by man hours, by machine rates, and by production factors."[1]

Percentage on materials. — An infrequently used method of distributing expense, and one which has little to recommend it, except its simplicity, is to divide expense as a percentage added to the cost of direct materials. Inasmuch as the cost of materials changes frequently, this method gives fluctuating ratios and unstable total costs. Expense is likely to increase less rapidly than output; it is likely to vary inversely with the quality of materials used; but it remains almost entirely uninfluenced by changes in the price of materials.

Percentage on labor time. — If direct labor time is classified according to the jobs upon which it is expended, it will be possible to distribute expense as a rate per man hour. Such a

[1] Chas. B. Going, Principles of Industrial Engineering, N. Y., 1911, p. 97.

system of spreading exerts a pressure upon the management to save the time of the force. In this respect policy follows fact, in so far as expense is a function of time; but overemphasis of time endangers quality of output, increases wear and tear on equipment, and endangers the health of employees. Furthermore, such a system of spreading leaves out of account the difference in the cost of equipment provided for different workmen. If an operative at a bench, working with a kit of tools worth $25.00, spent an hour on a job he would draw down as large a proportion of expense upon his job as would a machinist who used a $2,500.00 planer for the same length of time. To ignore the cost of special equipment in assessing individual jobs may, perhaps, incline foremen who are competing for low cost records to outrun each other in recommending the purchase of new machinery to save labor time, but it fails to bring out the expense of allowing equipment to stand idle or be operated at a speed below its capacity.

Percentage on labor cost. — To tabulate expense as a percentage on direct wages is a simple plan, and one very generally used. As it emphasizes wages it appears to recommend the policy of employing cheap men; a policy which becomes fallacious when incompetent men are selected, since such men increase factory expense rather than diminish it. This system, like the preceding one, fails to distinguish between jobs which use expensive machinery and those which employ little equipment.

Percentage on prime cost. — The use of this plan depends upon no principle of superiority in theory, but entirely upon the practical circumstance that prime cost is a perfectly clear concept, and that the figure representing it is usually at hand. A mere favorable ratio of burden to prime cost is of no significance, for burden may be kept relatively low by swelling prime cost items.

Machine rates. — A machine rate is composed of items withdrawn from expense, and representing the more important

parts of the cost of operating a given machine or other large unit of productive equipment. It is spread as an hourly charge upon all work using such equipment. A machine rate may be used when any of the previously mentioned systems are used to distribute the remaining items of expense; its effect will be to amend their neglect of equipment. As ordinarily composed, a machine rate includes charges for interest, depreciation, and repairs, and for power consumed. The machines are not rated separately, but are grouped into classes, each class having an expense rate.

As these hourly rates are based upon the assumption of continuous use, if a machine lies idle, an idle-time charge accumulates, which must either be spread as a supplementary machine rate upon the jobs using the machine, or be thrown into general expense and spread over all jobs. When machines are operated overtime there is created a supplementary rate which must be deducted from the full-time rate.

It is probable that a very large percentage of manufacturing establishments are overequipped in some particular. It is, therefore, a corrective policy to make the costliness of idle equipment stand out as distinctly as possible, by making a separate calculation of the loss, in the form of an idle-time charge.

The penalized job. — After the various classes of machines in an establishment have been given an hourly rating, if a job is transferred from the proper machines, because they are all occupied, to an idle machine of higher rating, it does not seem fair to penalize the job by the amount of the difference in the rating. No greater offense has been committed than to use equipment which would otherwise have been idle. The proper relief is either to carry the extra charge to the jobs normal for the machine used, or else to throw the item into general expense.

Production centers. — As cost accounting analysis has progressed, a tendency has shown itself to enlarge and perfect the machine rate, by including more and more items of expense

in it, and by dividing the machines of an establishment into a larger number of classes so that each machine may carry an hourly rate which is approximately correct. The culmination of this tendency is the proposal to divide the entire working space of an establishment, including the locations of machines and work benches and erecting floors, into a series of production centres. For each of these centres an hourly rate or rental is to be calculated which shall include every item of expense properly chargeable to manufacturing.

The conception has thus been elucidated by Mr. R. R. Keely. "In a machine shop each workplace may be regarded as enclosed by four imaginary walls, forming a room of suitable size for the performance of its operation. Each workplace is then considered as a unit in itself from which profit may be made in turning out a product. It may be conceived as rented to an individual workman.

"If all the workplaces are rented, then the source of income is not on product sold, but altogether from rental of the available useful space of the manufacturing plant. All space, however, cannot be turned into rentable workplaces, for there must be general heat, light, and power plant, storage space, aisles, halls, passages, offices, etc. . . . Each workplace unit must bear its share of interest and depreciation on its building, interest and depreciation on the cost of machine, taxes, insurance, etc., on the investment, repairs, and maintenance of building and equipment, its share of heat, light, power, etc., as well as all other general charges. The cost of the product from each workplace is made up of rental, raw material entering into the product, and a fair compensation for the worker. . . . Provision must be made for the idle time of a workplace." [1]

Into this production-centre rate will be inserted rentals for all service workmen and service departments, and for general management, just as in a modern high-class apartment

[1] R. R. Keely, Overhead Expense Distribution, Am. Soc. Mech. Eng., Feb. 8, 1913.

house the rental is made to include charges for elevator service and janitor service. This system of handling expense may be complex, but its leading champion, Mr. A. H. Church, boldly says, "No facts that are in themselves complex can be represented in fewer elements than they naturally possess."[1] The discussion of this system is doing much to advance cost analysis.

Conclusion on spreading systems. — No spreading system can attain theoretical accuracy. The degree of accuracy insisted upon must be conditioned by the demand for other virtues such as speed, economy, and simplicity. As Mr. D. S. Kimball says, "The method adopted should be as simple as the problem will permit. Thus, it would be folly to install an elaborate machine-rate method in a continuous process plant manufacturing a single commodity, where a percentage-on-material method is amply accurate. Again, in cases where a few lines of goods are made on small machines of low value, the percentage-on-wages or the hourly burden method may be fully adequate. Where the lines of production vary widely in size and character these simple systems are not sufficiently accurate, and a careful manager will go as far as he can in the direction of a machine rate."[2]

A tabulated summary of cost items is here introduced to indicate the general relation of spreading systems to each other.

Administration of Cost Accounting

The preceding brief review of cost items and of the methods of distributing them serves to show that cost accounting is an important instrument of analysis, of which no business administrator can afford to be ignorant. Mr. Church has defined cost accounting as a means of showing "The connection of expenditures of all classes with the items of output to which they are

[1] A. H. Church, Production Factors in Cost Accounting and Works Management, N. Y., 1910, p. 172.

[2] D. S. Kimball, Principles of Industrial Organization, N. Y., 1913, p. 138.

	Cost items	Method of Distribution		
Prime Cost	Direct materials.......	Direct		
	Direct labor..........			
Department Expense	Foremanizing and other department indirect labor..............		As a % on materials, or labor time, or labor cost, or prime cost	As a production-centre-hour rate
	Shop space...........			
	Machinery............	As a machine-hour rate		
	Supplies..............			
Factory Expense	Power................			
	Buying and Stores Depts..............			
	Receiving and shipping			
	Tool room............			
	Engineering (repairs)...			
	Drafting room.........			
	Planning room.........			
	Gen'l Supt. office......			
General Expense	Employment office.....	As a % on mfg. cost or divided between mfg. cost and selling cost.		
	Accounting...........			
	Legal.................			
	Welfare Dept..........			
	Gen'l Officers, Directors			
Selling Expense	Advertising...........	As a % on manufactured cost.		
	Credit and collection			
	Agency expenses.......			
	Salesmen.............			
	Sales Mgr.'s Office.....			

incident."[1] Proprietorship accounting ultimately sums up all items of expenditure into its totals, but it does not measure the items near enough to their sources to reveal the relation between expenditure and production in detail. Cost accounting, on the contrary, is a scheme of measuring expenditures as close as possible to the time and place of the productive acts

[1] A. H. Church, Distribution of Expense Burden, N. Y., 1913, p. 13.

which give rise to the cost. The object of securing this record at the point of origin of the outlay is twofold, first, to get a record sufficiently dissected and analytical in its nature to reveal the relation between expense and output in detail, and so reveal the cost of a unit of product; second, to so measure the outlay on account of men, machines, materials, processes, gangs, departments, agencies, plants, etc., that when this record of costs is brought into comparison with a record of like detail and corresponding classification, showing useful work done, the efficiency of each agency of production can be measured. Cost accounting is, therefore, an instrument of precision in the hands of the administrator: it is one of the many special forms of scientific analysis available as a means of control.

When accounts are essential. — A good system of cost accounts is especially to be desired whenever costs are fluctuating, when high-priced labor or expensive materials are used, or when the margin of profit in an enterprise is narrow, so that selling prices must be set with care. Accurate costs are useful as a sort of stethoscope for revealing the internal conditions of a business where much delegation of authority exists, or where proprietorship rests in the hands of persons not technically expert, and so unable to gauge efficiency by the process of intuition. The early warning which cost records give of changing conditions is invaluable as a safeguard in disturbed and critical times, or when extraordinary expenses are being incurred, or when large contracts must be entered into on the basis of preliminary estimates. An establishment which makes a considerable variety of products can discover the lines which are most profitable, and so determine the true field of its enterprise and its proper function in the business world, only by a cost system.

Limits of Elaboration. — It has become somewhat habitual to think of red tape in connection with accounting. This is probably due to the carrying of the balanced-to-a-cent rigidity of bank accounting (fiduciary accounting) into industrial insti-

tutions; and the extension of a centralized requisition and voucher system to the petty acts of high officials not at headquarters, so that the salary equivalent of the time taken to comply exceeds the amount of the items involved. As a cost system is simply one administrative agency among others, its development, and the expenditure proper to incur on account of it, must be controlled by the general law of coördination or of equal utility of marginal outlay.[1] This means that it should end at the point where any further expenditure upon it will yield a less return than could be secured if that expenditure were made to improve some other feature of the enterprise. Beyond this point lies the domain of red tape.

The order system. — To ascertain costs it is necessary to bring under control all the activities in connection with which they are incurred, to the end that there shall always be a record where there is an expenditure. Such control is obtained by establishing the rule that no expense is to be incurred without an order; and that orders go into effect through a prescribed method of authorization, and are concluded by a prescribed form of report. For such operatives as are subject to strict and detailed guidance in their work an order will appear to have the character, chiefly, of a written instruction to do certain things. But for those officers who receive infrequent, informal, or general instructions, and in whom is reposed much discretionary power, the order system will appear, chiefly, as a particular manner of requisitioning supplies, or of reporting acts performed. In the shops an order system will mean that no materials can be secured except on a requisition bearing an order number, and that no workman's labor can be put on anything not specifically authorized, and accompanied by a job ticket bearing an order number. In the shops, each new lot of goods to be manufactured will require a new order, for there each order will expire as soon as work on the particular lot of materials or articles covered by it is finished. In the service

[1] See Chapter VII, p. 144.

departments and in the executive offices, where outlay cannot be directly coupled with any individual unit or lot of goods, the order will be, in reality, the title of a certain permanent class or subdivision of expense, under which each particular outlay is to be reported. Such orders will be permanent, so that we may speak of a system of standing orders as prescribing a certain classification of items in all requisitioning and reporting. Some of the leading entries among standing orders will be additions to buildings, repairs to buildings, new equipment, repairs to equipment, department payroll, stationery, royalties, legal expenses, advertising, and insurance. The classification of these orders is important, since it conditions the analysis of expenditures.

Cost accounting versus proprietorship accounting. — Cost accounting is a thing quite different from proprietorship accounting. The latter aims to show, by means of the balance sheet, what property there is at a given time, and what the claims of ownership are to it. By means of its trading, profit and loss, and revenue statements, it shows, in summarized form, what the receipts and expenditures have been for a period of time, what the profit or loss has been, and what disposition has been made of the profit. Proprietorship accounting keeps the records of financial relations with outside parties, as the law requires; it maintains a check on fraud, internal and external; it constitutes one proof, among others, as to where ownership lies; it shows whether or not the capital fund is properly proportioned between the various forms of fixed and current assets; and establishes the condition of a business with reference to insolvency and bankruptcy. Cost accounting, on the other hand, aims to collect all the items of outlay, great or small, incident to the production of a unit of goods or services. It uncovers the causes of fluctuations of expenditures, and indicates the true field of profit. It aims to measure the efficiency of all the agencies of production, in so far as this can be done by the use of a scale of monetary

value. Proprietorship accounting admits only veritable original items: it balances its data in the form of debit and credit: and when in perfected form insists on the fine equilibrium of being balanced to a cent. Cost accounting freely uses estimates and averages, distributing sometimes more and sometimes less than it collects. One of these systems has had a long history; the other is of recent origin. One is the special instrument of the financier; the other is the daily working tool of the production engineer and works manager.

In spite of these distinctions of aim and method, cost accounting and proprietorship accounting should be interlaced into one harmonious system of financial records. The connection will be made through the introduction of the totals of the control accounts of the cost system as items in the trial balance and in the profit and loss account. Thus tied together, the cost system serves as an intensified study of certain items in the proprietorship accounts, while the proprietorship accounts serve as comprehensive surveys which make certain that all proper items have been introduced into costs.[1]

Uniform cost systems. — The establishment of a uniform system of cost accounting for the individual establishments in a branch of industry exerts a great influence toward stable conditions and friendly relations. Without such uniformity in the cost-calculating process, competition is not able, in the more complex industries, to establish agreement as to what fair cost is. Without it, therefore, a market can never reach anything better than an approximate and unstable equilibrium as to prices. The chief reason why unanimity of opinion as to costs cannot be reached, when different systems of accounting are used, is that there are many different ways of grouping and

[1] For the argument that cost accounts and proprietorship accounts should be kept separate, see H. P. Gillette and R. T. Dana, Cost Keeping and Management Engineering, N. Y., 1909, pp. 65–70. For the opposite view, see A. H. Church, Production Factors in Cost Accounting and Works Management, N. Y., 1910, Ch. VII, pp. 163–187.

spreading overhead charges or factory burden. Even a comparatively simple item like the cost of raw materials may, in ordinary practice, include any grouping of a dozen or more different cost elements. The line between direct and indirect labor is not drawn alike in two plants. In calculating the depreciation of buildings and equipment, some concerns use the straight-line method, or calculate a fixed percentage from the original value annually; others deduct a fixed percentage from an annually diminishing value; and still others make no regular allowance but either set aside lump sums out of profits from time to time, or trust to offsetting against depreciation the appreciation of such assets as real estate or good-will. With such diversity of practice it is apparent that competitors cannot act upon the same concept as to cost, and cannot, therefore, establish their prices in any definite and fair relation to cost. Profits are, therefore, arbitrary and uncertain, and not standardized as "converting profits."

It is well known that injurious competition often has its origin in the suspicious state of mind which is generated among rivals who do not know where the bottom rock of cost is. Rumors of cuts are given credence because the knowledge is not at hand to indicate their improbability; and such rumors are responded to more promptly because the folly of the action is not at once apparent.

The introduction of a uniform system of cost accounts by a number of concerns in the same line of industry, as the result, perhaps, of the activity of a trade association, invariably brings these establishments into a state of intelligent reaction upon each other. Competition is not extinguished, though that abnormal form of it which consists in setting prices below cost may be discouraged. The interests of the public are better served in the long run, because the leadership toward lower prices comes from well managed concerns of enduring power as factors in the market rather than from experimenters and price gamblers who exert but a temporary influence. Where costs

are intelligently dealt with by a group of producers, the price pressure of the leaders bears down discriminately at those points where improved efficiency is possible for others.

When once all the items of a normal and proper cost are enumerated and brought into clear view, the idea of maintaining fair prices becomes a sign of intelligent management, and even a point of honor. By this means financing is made easier and capital flows in to work a greater ultimate reduction in price, through the effect of good equipment and production on a large scale, than disorderly market wars could ever effect. Managements are released from the excitement of commercial and financial experimentation, and set to work upon those matters which constitute the proper domain of manufacturing activity. When the Bureau of Business Research of Harvard University began an investigation of the retailing of shoes, it was obliged, as the first step, to formulate a system of accounts and introduce it into the coöperating establishments. Until that was done the reports of different establishments, showing different costs, prices, and profits, reflected differences of accounting method quite as much as they did differences of local conditions and business policies.

As the contact of business men in the same line becomes more educative, by reason of agreement as to the real nature of the contest being waged with cost, trade associations are strengthened. The discussions of business gatherings become less rambling and popular, and more vital and searching. The impulse which a group of business men in a similar line gathered together naturally feel to adopt a temporary panacea, and control the market by some artificial means, is replaced by a desire to use their assemblage as an occasion for studying efficiency. The result of these influences is to work out a more rational division of territory between individual establishments in the same trade, and a better division of functions between allied trades. Unprofitable lines are more quickly dropped, unprofitable departments are more readily eliminated, and

unprofitable establishments are more promptly closed. This purging action releases much unnecessary capital investment, and cuts off much unnecessary operating expense.

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CHAPTER X

THE EMPLOYMENT OF LABOR

Introductory. — The labor problem is a manifold thing, composed of many parts. If we arrange a few of these parts somewhat in the order in which they will present themselves in the term of an individual labor contract, the list will appear as follows:

(*a*) employment: a bargaining process and a legal contract,
(*b*) shop training: a form of delayed vocational training,
(*c*) discipline, through shop rules,
(*d*) the working environment, embracing such matters as lighting, heating, ventilation, and the convenience of machine design,
(*e*) measurement of work done,
(*f*) reward in wages, and promotion or discharge,
(*g*) welfare work, that "something more than wages" which gives evidence of the employer as a social being in contradistinction to an "economic man."

The cost of a shifting force. — In the course of an inquiry made into the irregularity of employment, the Russell Sage Foundation discovered that a certain mining company employing on an average 1,000 men, was obliged to hire 5,000 new men each year, to maintain its force. A large machine shop, with a force of 10,000 persons, was found to have taken on 21,000 new employees in a year. Another large concern was recruiting at the rate of two men per year for every man on the average force. The Consumers' League of Eastern Pennsylvania found that the three telephone companies of

Philadelphia, averaging 3,000 women employees, had 30 per cent of resignations and dismissals per year. The average service of girls employed by the Michigan Telephone Company has been found to be 20 months, showing a 60 per cent rate of annual change. Making some allowance for the special difficulties of telephone companies, these records and others of similar purport are characteristic of what is called the hiring and firing process, a recruiting method which consists of promiscuous hiring, costly sifting, inadequate adjustment, and early discharge.

Every new employee introduced into an establishment, and adjusted to a particular place, entails an expense over and above what the continued service of a former employee would have cost. This expense has been estimated many times; and it appears to be the prevailing opinion that it is in the neighborhood of $100 per employee. Where a force shifts at the rate of a complete turn-over each six months, the cost of recruiting may amount to 20 per cent of the payroll expense. This cost is made up of the expense of the employment department, the extra attention required of foremen, the low rate of initial performance, the cost of spoiled work, the high accident rate, and the extra wear and tear of equipment. No allowance is made in these calculations for the lack of team work in gangs and departments where new and old employees are placed side by side; nor is any made for the low average performance which is likely to characterize a group of workers as long as novices or obvious misfits among them are permitted to establish a poor performance as the permissible minimum. No allowance is made for the uneasiness and lack of loyalty of a constantly shifting force.

The employment officer. — In small establishments workmen are recommended, if not actually hired, by the department foremen. In concerns of size it is profitable to entrust the employment of all persons below a certain rank to one officer. By this plan complete records can be established in one place,

and experience can be made cumulative in developing some degree of skill in the chosen officer. The employment officers of a locality, if organized into an Employment Managers' Association, can come together for the study of the methods essential in their work, and can exert an influence in favor of vocational training and vocational guidance.

Promotion.[1] — A position may be filled either by the promotion of an employee from an inferior place, or by shifting an employee from a place of equal rank, or by the introduction of an outsider. To firmly establish the policy of promotion means to open a future inside the business for each person, and to make ambition a centripetal instead of a centrifugal force. To do this, functions must be grouped in such a way that the positions created will stand, with reference to each other, in a graduated scale, across the intervals of which it will be possible for individuals to move at the rate of normal development, until the limit of their talents is reached. When persons are thus linked together, each superior becomes a pattern and each subordinate an understudy. The superior is released from detail, and gains a counselor whose judgment has the freedom due to exemption from direct responsibility. As the understudy grows toward the superior in knowledge and power, the latter perceives that he is no longer indispensable, and strives to rise into a higher world of efficiency.

Transfer. — If a record is kept of the kinds of experience possessed by employees, and their natural aptitudes, it will often be possible to improve the adjustment of a force by shifting. Some of the establishments operating under scientific management use slack times as schooling periods. At such times many workmen are shifted temporarily to new tasks for which they have shown aptitude. The object is to teach every man a second or reserve employment, not only with the hope of discovering latent talents which may lead to permanent transfers, but in order that the temporary shifting

[1] See Chapter VII, p. 147.

required by rush orders or unequal pressure of work on different shops may be more easily made. In slack times a management can best spare the time to explore the hidden capacity of its operative force, for at that time the slowness of an experimental or learning process can best be endured.

Sources of supply. — Out of 750 employers, who reported in 1911 to the New York Commission on Unemployment, there were 458 firms, or 60 per cent, who secured practically all of their help from those making personal application to them. Two hundred firms advertised in newspapers, in addition to choosing from those who offered themselves. Fifty used employment agencies; 10 depended upon the trades unions.

If a concern has a good reputation as an employer, new candidates may be secured from among the friends and relatives of the force, by merely posting notices about the works. Public advertising has the drawback of creating restlessness among employees, from the fear of discharge. But if an advertisement of help wanted is published without giving the name of the advertising employer, the best class of men will pay no attention to it. If an employer asks for references with the first application of a candidate, those persons will be eliminated who do not wish to have their present employers know that they are looking elsewhere. Even unemployed persons realize that the patience of previous employers must not be taxed too frequently by the requests of prospective employers for information.

Employment agencies. — Employment agencies are useful chiefly in securing low-grade labor in large quantity on short notice, as for railroad construction or other contract work. There is a strong tendency to discriminate against the agency, and this feeling operates to restrict it to the business of placing "floaters" with such firms as are always having labor troubles. Public employment agencies are, in general, below even the very moderate standard of efficiency attained by American

municipal and state governments. Mr. Wm. M. Lieserson, who as a member of the Wisconsin Industrial Bureau was largely instrumental in making the Wisconsin agencies an exception to the above judgment, has said of public agencies in general, "With few exceptions their operations have been on a small scale, their methods unbusinesslike, and their statistics valueless if not unreliable." The Illinois agencies upon which the state has for 14 years spent $50,000 annually, the late Professor Chas. R. Henderson pronounced almost complete failures. Here is a task for employment managers. In some states, notably Wisconsin, a beginning has been made of better things. The agencies of that state are organized into a system, through the prompt interchange of information.

In that state an effort has been made to solve the problem of the "short job." Under usual conditions, in cities of any size, there are too many men attempting to live on short jobs. Each of these persons gets a job now and then; but the class as a whole is miserable, and but intermittently employed. The Wisconsin plan is to select from the casual labor class a group of men fitted for miscellaneous unskilled work, and not more numerous than can be kept continuously employed. The men of this group are carefully scheduled from one job to another. By turning others away from this class of work entirely, the extra supply is gradually disposed of in permanent positions, or is distributed to other localities. When such a program is being followed by the public agencies, the employers of floating labor should coöperate by dismissing the lines of waiting men at their gates, and by taking casual laborers from the selected list only.

Employment rules. — The following rules may be considered in forming the policies of an employment department:

1. Fill places by promotion when possible.

2. Hire with care. It creates an attentive teachable state of mind in a candidate to observe that it is not easy to get in. Careful hiring will abolish wholesale firing. Harrington

Emerson has pointed out the noble ideal toward which first-class administrators should work. He has said, "It ought to be as difficult to enter the service of a great corporation as to pass an entrance examination to West Point; but once in, it ought to be a catastrophe for a man to be forced to leave, because the company provides so much that he cannot provide himself, for his physical, financial, and professional welfare."[1]

3. Elaborate the interview or the preliminary correspondence, with a view to judging the candidate from his expression of himself rather than from the testimony of others.

4. In examining letters of recommendation look especially for the opinion of such employers as are noted for their care and success in hiring. Of letters of recommendation President Emeritus Chas. W. Eliot has said, "Experienced officials pay but scanty attention to testimonials and letters of recommendation, particularly if they have been forwarded through the candidate, or procured by him. Americans are apt to be too charitable and good-natured when writing letters of recommendation. They are also fond of superlatives, and are too apt to deal only with merits, omitting defects, when they write testimonials at the request of a candidate."[2]

5. Somewhat overstate the disadvantages and understate the attractions of the prospective position. During the period of application, the candidate is likely to view the desired place in somewhat too rosy a light, especially if it is to take him in from the cold world of unemployment. Some sobering of the picture only serves, therefore, as a correction by which things may be seen as they actually are. Furthermore, by this policy, those looking for soft berths and those of little tenacity of purpose are discouraged. Those who are finally employed will be agreeably surprised to find the reality better than the promise.

[1] Harrington Emerson, Efficiency as a Basis for Operation and Wages, N. Y., 1912, p. 58.

[2] Chas. W. Eliot, University Administration, N. Y., 1908, p. 91.

6. Observe the distribution of talent. Men trained to unusual specialties are most likely to be found in large cities where the differentiation of functions is greatest. Simplicity of character and personal loyalty is most apt to spring from village conditions. To have held position in noted centres, such as Detroit for automobiles or Grand Rapids, Mich., for the furniture industry, where the rivalry of standards is intense, is an evidence of capacity in an employee. One should look for the circumstances which stress a certain phase or type of performance. The men who do a certain kind of work well enough to pass muster in places where the accomplishment is either unusually difficult or unusually important are likely to know how to do it well; they have been developed by stress of external circumstance or of internal necessity. Establishments or departments presided over by men noted for ability in certain lines may be looked upon as training schools for labor, from the outside employer's point of view. Competent employees of such departments are graduates who can carry with them the methods they have learned. The service departments of machine-manufacturing concerns may often be consulted with advantage, for they are interested in having their machines efficiently operated. The R. Hoe and Company conducts a training school for pressmen. The Mergenthaler Linotype Company does the same for operatives of its machines. Trade expositions sometimes serve, incidentally, as clearing houses for foremen, tool makers, draftsmen, designers, and others skilled in special lines.

7. Avoid the creation of blind-alley occupations, or occupations which interfere with the school education of youths, and do so without offering the offsetting advantage of giving a specific training for a higher position. Many occupations, such as folding, wrapping, sorting, and pasting, can be abolished by the introduction of machinery, or by this means be raised to the plane of adult occupations. For the irreducible minimum of uneducative youthful labor, involved in such work

as tending door and running errands, the shop school or public continuation school are the proper counteracting agencies.

8. Before the final discharge of a man, a reasonable effort should be made to discover his aptitudes by transfers. At the plant of The Ford Motor Company in Detroit, the power of discharge from the establishment is not lodged with the foremen; they can only discharge men from their departments. An employee, upon receiving a departmental discharge, reports to the employment office, which places him in some other department. No one is finally dropped until a succession of departmental discharges has demonstrated his general inefficiency. A system very similar to this is used by The Wm. Filene's Sons Co., in Boston.

9. Avoid a general lay-off. The problem of unemployment is a constant invitation to some form of radical public initiative such as the inauguration of extensive public works, or the adoption of some form of unemployment insurance. Those employers who dislike the extension of public initiative should remember that they may make a contribution toward the solution of this problem by regularizing their own establishments. Conspicuous successes have already been achieved in this by establishments in some of the most seasonal industries; so that the plea that it is impossible to maintain a regular force must not be taken too seriously.

10. A discharged employee should be protected as much as possible. A discharge, even administered with the utmost diplomacy, is a blow to pride, and an experience which tends to break down courage and self-respect. Fairness demands that the minimum of injury be done to one whose failure may be more than half due to some oversight or inadequacy of the employer's agents. Besides, it does not pay to turn loose an enemy.

The psychology of employment. — The evolution of experimental methods in psychology is preparing the means of more accurately assigning men to the occupations for which nature has specially endowed them. Competent psychologists are

now prepared to test the sense impressions as to their vividness, accuracy, and range. They can measure the reaction time, or the speed of response to various forms of sense impression. By memory and association tests, the nature of the mental imagery can, to some extent, be laid bare and the customary thought paths revealed, to show the vocabulary, the acuteness of the intellect, the direction of interest, and the particular concepts which associate themselves with emotion. Dexterity in various simple mental and manual processes may be determined. And so the psychologist is proceeding gradually toward the discovery of what holds the attention, what pleases, what excites to anger, and what dominates the ambition. By exploring the world of sensation and affection, advance is being made toward determining the quality of consciousness and the springs of individual action.

Upon the basis of such investigations, there is already being suggested certain classifications of individuals which promise to become of practical value to the employer. Professor Muensterberg refers to the men who are interested in handling physical things, as contrasted with those whose dominant interest is in dealing with people, and with those who naturally labor in the service of ideals. And the same investigator refers to tests which will distinguish mental efficiency from manual efficiency, will divide the settled type of men who complain of upsetting changes from the roving type who complain of monotony, and will differentiate the dependent individuals who evade authority from those directive personalities who seek it.[1] The best known classification is that of Wundt, according to which a fourfold division of temperaments is made, "On the ground that, in every individual, there must be a certain combination of the two factors of strength and speed in that change which all mental processes undergo. The affections of the mind are therefore classifiable as either strong

[1] Hugo Muensterberg, Vocation and Learning, St. Louis, Mo., 1912, p. 265; Psychology, General and Applied, N. Y., 1914, pp. 417–418.

and quick, or strong and slow; or else as weak and quick, or weak and slow. By crossing these two principles of division the following scheme is derived:

	Strong	*Weak*
Quick	Choleric	Sanguine
Slow	Melancholic	Phlegmatic

"The quick temperaments are directed rather toward the present, the slow toward the future. The quick require additional strength, the weak additional time, in order to achieve the largest amount of work possible for them. The choleric and phlegmatic are temperaments with respect to action; the sanguine and melancholic are temperaments with respect to feeling."[1]

The evolution of industry is turning employers toward psychology. The increasing fineness of the division of labor, the greater significance in modern labor of special mental endowments, the accuracy of adjustment of the factors of production aimed at by the advocates of scientific management, the attention attracted by the movement for vocational guidance, and the publication of cost data with reference to the "hiring and firing" process have created an intense eagerness for anything which bears the word psychology. There remains, however, an immense amount of scientific work to be done before psychological tests will be serviceable in the employment department. The apparatus for exploring the sense impressions and the affections can only be practically applied when the various occupations have been resolved into their essential component psychological elements and the relative significance of these parts in attaining efficiency has been determined. In this analysis scarcely a beginning has yet been made. Occasionally the psychologist can devise a complex laboratory test which reproduces the essential psychological situation of an occupation: of such tests barely a dozen have as yet

[1] G. T. Ladd, Physiological Psychology, N. Y., 1892, p. 458.

proved their value. In this juncture the true scientist asks for time, and for the facilities for investigation; but, meanwhile, the commercial exploiter rushes in, and offers a mixture of phrenology and palmistry, promising to practitioners the speedy development of an uncanny power of divination.

The solution of the problem of adjusting talent to function will require the support by society of largely increased facilities for pure research in psychology. It will require, also, the introduction into industry of a new type of specialist — a man who is as competent in psychology as the engineer is in physics, or the physician in physiology. It will require a special development in the schools, to permit the prolonged observation of the abilities and tendencies of the young; and so to supersede the ridiculous efforts now being made to measure and catalog personalities in a single interview. It will require, finally, the establishment of bureaus of vocational guidance to apply the economy of a clearing house to functions which most employing concerns can never afford to perform according to the highest standards of science.

Law of the labor contract. — Legally considered, the contract of employment must contain the same essentials as other contracts, namely, two parties competent to contract, a lawful consideration, a lawful object or subject-matter, and mutual assent or an agreement of minds. If any one of these elements is lacking the contract is void. The existence of a contract may be implied by the conduct of the parties without any direct discussion of terms, as where one labors for another with his knowledge and consent. When, after the expiration of a contract, one continues to labor for another with his knowledge and consent, a new contract is thereby formed for the same period, and on the same terms as the previous one. If a contract for employment is for more than a year it is only valid, under the Statute of Frauds, when put in writing.

Term. — If the term of a contract is not stated it may be implied, either from the custom of payment (it being reason-

able to suppose that employment is to endure until the next regular pay day), or from the customary term of contracts for the like class of labor, or from the expenditures and sacrifices made by either party to carry out the conditions. If a man moves his family to a new place specifically to accept a salaried position, it may be assumed that the period in contemplation between the parties was more than a week or month. In general, however, if employment is for an indefinite period, it may be terminated by either party without notice.

Specific enforcement. — The law will not compel the enforcement of contracts for personal services. The courts have no means of establishing a guard over a man to see that he performs his work. The remedies for non-performance are, therefore, discharge, and action for damages.

Discharge. — An employer has a right to discharge an employee for (1), wilful disobedience, (2), misconduct, (3) negligence, and (4), incompetence.

Disobedience. — Not every act of disobedience is ground for discharge. If the orders of the employer are contrary to, or outside of, the terms of the contract, or are unreasonable, or impossible of execution, obedience is not required.

Misconduct. — Misconduct which injures the employer's business is ground for discharge. To disclose the employer's business secrets, to foment discord among co-employees, or induce co-employees to quit the employer's service, to take bribes from subordinates, or to steal the employer's property, are some of the acts justifying discharge. Drunkenness as a habit, or on specific occasions when the employer's interests can be proved to have suffered, is sufficient cause for discharge.

Negligence. — Negligence, like misconduct, must be of such a nature as to injure the employer's business, before it becomes cause for discharge. Illness for a considerable time operates, within the meaning of the law, as negligence. Absence without good cause, especially in the case of those in responsible positions, is material. For a similar reason, the delegation of

duties to another without notice to the employer, especially where the question of competence is an important one, as in the case of an architect or engineer, is not sufficient performance.

Incompetence. — An employee is responsible for any misrepresentation, express or implied, as to his skill, experience, capacity, or training. In undertaking work an employee, in effect, affirms his ability to perform it. Nor can he plead ignorance of the nature of the work, at the time of entering upon the contract, if no fraud on the employer's side prevented his securing the information. If, then, the employee reveals his inability to perform the work, even though he may work with all his energy and talent, he may be discharged. If an employee accepts added duties while employed, he is bound to perform them, for he has entered into a new contract to do so. He might, lawfully, have declined to perform them, without invalidating the original contract, but having once assented to the new duties, he is bound for their proper performance.

Wrongful discharge. — If an employee has been wrongfully discharged, and has acquiesced, he has thereby released the employer from all liability. When there is a question as to whether or not a discharge is absolute, the proper course for the employee is to tender his services until they are definitely refused; for performance, or tender of performance, is required of one party before he can require performance by the other party. When an employee has been wrongfully discharged, he is bound to seek similar employment with reasonable diligence, in the same general locality. Failing in this, or securing less remunerative employment, he can then hold his original employer liable for his wages, or for any deficit in his wages. He is, however, not bound to accept employment of a different kind. To illustrate, The Central Leather Company had bought out an independent concern. The superintendent of this concern had been engaged for a year, and refused to resign before the expiration of that term in favor of the company's new superintendent. He was notified to appear at

the factory and earn his $8,000 salary by working as a factory hand, until the expiration of his contract. This he did, thinking it necessary in order to maintain his rights. His only duty would have been to make a reasonable effort to obtain another position in the same locality with activities substantially the same as before. Failing in this, he could have recovered the balance of his year's salary without working as a factory hand.

Condonation of offense. — An employer having once condoned an action cannot later discharge the employee for that action alone. The retention of an employee, after his services have become unsatisfactory, operates, in general, as a waiver of breach of performance, and entitles the employee to his wages or salary for the period; but it does not afford conclusive evidence that the employer has completely condoned the offense, for he has a right to take into consideration the significance of a series of offenses in determining competence. An employee once wrongfully discharged cannot later be ordered to return to work and, failing to do so, be legally discharged for this as a breach of performance. There can be but one discharge under one contract.

Collective bargaining contracts. — The following headings and specimen clauses are presented to show the character of the agreements which are more and more frequently being entered into between employers, or organizations of employers, and organizations of employees. They may serve as a guide in drawing up agreements where collective bargaining takes place.

1. *Definitions as to the nature of work or the standards of craftsmanship:* Such definitions are introduced into agreements, either for the purpose of reserving certain kinds of work to men of a given trade, or to classify work with reference to wages, or to limit and define the application of certain types of equipment or of certain methods of doing work.

Definition of a craft: "All pointing on stone and brick walls

done with the trowel, and floating plastering, shall be done by masons, and all stonework, whether laid up dry or in mortar, shall be considered mason work, and shall be done by masons. It is agreed that brick floors, laid in sand and then grouted, can be laid by any one the contractor may deem fit; but brick floors laid in cement mortar is mason's work, and must be done by masons."

Mason Contr's Asso. of Rochester, N.Y., and Bricklayers', Plasterers', and Stonemasons' Union, 1910.

Definition of a craft: "Boilermaker's work is defined as follows: cutting apart, marking off, laying out, and building work pertaining to steam, water, air, and oiltight sheet and plate work from number sixteen gauge iron or steel and upward; boiler inspection and testing, flanging, patching, riveting, chipping, caulking, and tube work."

Boston and Maine R.R., and Boilermakers, 1908.

Country work: "Country work means work performed by a worker which necessitates his lodging elsewhere than at his usual place of residence." [Some usual provisions of country work contracts are: the worker to be conveyed to work, or have his travelling expenses paid once going and returning during the continuance of the work, time occupied in travelling to be paid for at ordinary rates, and workers to be paid an additional sum of —— per week, or in lieu thereof, receive board and lodging free.] — *New Zealand clause.*

Suburban work: "Suburban work means work performed by a worker at a distance of over two miles from his employer's place of business, but which does not come within the definition of country work. If the distance required to be travelled in order to reach the place be more than two miles from his employer's place of business, workmen shall be paid at the ordinary rate of wages for the time occupied in proceeding to the work, for the excess of such distance, reckoning the time taken at

the rate of three miles an hour. If conveyance is needed it is to be furnished or fares paid." — *New Zealand clause.*

2. *Policy of Employment:* Various stipulations are to be found, such as for a closed shop, for a closed trade, for the preference of union men when competent union men are available, and for the reservation to the employer of complete liberty in hiring and discharging.

Closed shop: "If the employer shall hereafter engage a worker who is not a member of the union, and who, within one calendar month after having been engaged, fails to become and remain a member of the union, he shall dismiss such worker, if called upon to do so by the union, provided that in such case the union shall provide a worker of good character, competent, and ready and willing to perform the work required to be done. Provided also that the rules of the union permit any person of good character, competent and employed in the trade, to become a member of the union upon payment of an entrance fee not exceeding —, upon his application, without ballot or other election, and so to continue upon continuing subscriptions not exceeding —— per ——, and to retire from the union without payment of anything in the nature of a fine or penalty."

— *New Zealand clause.*

Closed trades: "Only members of the party of the second part [the union] are entitled to do the work in the following lines, to wit: every kind of work in the brew-house, in the fermenting room, cellar, fill-out cellar, wash house, and pitch-yard, also all handling of empty or filled barrels, inside of the brewery, to drive on hoops, tending of machinery necessary to drive on kegs, cleaning pipes, whitewashing inside of the brewery, handling of all material necessary to the manufacture of beer and ale inside of the brewery building. Foremen and assistant foremen need not belong to the union."

Sixteen Buffalo brewers and
Brewers' Local Union, 1910.

Helpers: "Helpers and laborers will not be permitted to do boiler makers' work or be advanced to the detriment of the apprentice or boiler maker."

New York Cent. R.R. and
Intern. Brotherhood of Boiler Makers, 1910.

Helpers: "Machinists' helpers will not be allowed to undertake or execute such work [enumerated elsewhere in the agreement] as requires the skill of a mechanic, and must only come in contact with such work in such a way as to render assistance to a machinist or apprentice."

New York, Ontario and Western R.R. and
Machinists, 1910.

Promotion: "All employees in the telegraph service will be regarded as in line for promotion, advancement depending upon faithful discharge of duties, and capacity for increased responsibility."

Erie R.R. and
Telegraphers, 1910.

Promotion: "In case a blacksmith leaves, or the company starts another fire, the oldest smith or helper qualified for promotion shall be given the chance; and if he proves satisfactory he shall receive twenty-five cents additional every three months, until the full amount of that fire is reached. Should the promoted man prove incompetent to do the class of work done on the fire to which he has been promoted, after a reasonable length of time, he shall be set back, and the next in line given a chance."

Boston and Maine R.R. and
Blacksmiths, 1910.

3. *Hours of work:* Agreements relating to the hours of work specify variously, the number of hours constituting a day's work, the time of day at which work shall begin and end, the manner in which shifts shall be constituted, and the holiday periods on which work shall be suspended or paid for at extra rates.

Hours and holidays: "Eight hours shall constitute a day's work, all work to be done between the hours of 8 A.M. and 5 P.M. No work shall be executed on Saturday between the hours of, 12 noon, and 5 P.M.; all over that time shall be paid for at the rate of time and a half, except Sunday, New Year's, Washington's Birthday, Memorial Day, Fourth of July, Labor Day, Thanksgiving, and Christmas, which shall be double time."

Master Carpenters' Asso., Yonkers, N.Y., and Dist. Council Carpenters and Joiners, 1910.

Overtime: "All time worked above —— hours per day shall be considered overtime." "Overtime shall be allowed only for work done after the regular quitting time." "In calculating overtime each day shall stand by itself." "All time worked in any one day above —— hours, or in any one week above —— hours shall be considered overtime."

Shifts: "In case of necessity the employer shall have the privilege of working more than one shift of men within the twenty-four hours: straight time to be paid."

Employing Plasterers' Asso. of Buffalo, and Mason Builders' Asso., 1910.

The shift and wages: "If a night shift is arranged to fall chiefly between the hours of 9 P.M. and 5 A.M., work on such shift shall be paid at the rate of ——."

4. *Wages:* The principal points in trade agreements with reference to wages are: the rate per hour, day, week, or month, the rates of overtime wages, the method of calculating wages, as by piece rates or by a bonus system, the wages of apprentices and under-rate workers and part-time workers, the wages of temporary work, the wages of spoiled work, the manner of setting new rates, and the time and manner of making payments.

Overtime wages: "Overtime shall be paid at the rate of time and one-half." "All overtime up to —— o'clock P.M. shall be paid for at the rate of ——, after that at the rate of ——."

Apprentices' wages: "Scale of discounts for apprentice mould makers:

First year	$33\frac{1}{3}$ %	discount from full list.
Second year	25	" " " " "
Third year	20	" " " " "
Fourth year	15	" " " " "
Fifth year	15	" " " " ""

U. S. Potters' Asso. and
Nat'l. Brotherhood of Operative Potters, 1909.

Wages of temporary work: "Any man taking temporarily the place of another for a time exceeding one day, shall receive the pay of same during such incumbency, but such pay shall not be less than he is regularly receiving."

Brewers' Ex., Rochester, N.Y., and
Five local unions, 1910.

Wages of transfer work: "A man placed on a higher rated fire, machine, or hammer for one week or longer will receive the rate of such higher rated fire, machine, or hammer. Day workers placed on a lower rated fire, machine, or hammer will be paid their regular rates, unless the change is permanent on account of employee being incapacitated for his former work."

American Locomotive Co., and
Intern. Brotherhood of Blacksmiths and Helpers, 1910.

Wages of spoiled work: "Workmen spoiling work through negligence or other culpable error shall lose remuneration for the time put upon the piece. Employees shall not be obliged to lose the value of the time expended by them upon material which, through no fault of theirs, is discovered to be defective after they shall have worked upon it. Employees charged with the value of spoiled work shall receive credit for the value which the material involved may have for other purposes."

—*Rock Island Arsenal.*

Setting new rates: "New work will be priced within a reasonable time, and must be priced before 25 % of the total number of pieces are completed. The foreman will, if necessary, make a special allowance equivalent to the basic piece work rate to compensate the workman for any loss that he may sustain in starting a new job."

American Locomotive Co., and Internat. Brotherhood of Blacksmiths and Helpers, 1910.

Manner of paying: "Wages shall be paid weekly and be ready for delivery at the shop or at the job at which the men shall respectively be at work, at 5 P. M. on pay day, and half holidays at 12 noon." "Wages shall be placed in sealed envelopes, having endorsed thereon the name of the wage earner, the number of hours represented, the date of payment, and the amount enclosed."

Elec. Contrs. of Rochester, N. Y., and Local Union of Internat. Brotherhood of Elec. Workers, 1910.

5. *Apprentices:* With reference to apprentices, the matters to be settled are, the number to be permitted, the rate of wages to be paid [see Wages], the length of the apprenticeship term, and the class of work apprentices shall be allowed to do.

Number: "To a contractor working on an average the previous year two masons, one apprentice; five masons, two apprentices; and for every additional ten masons, one apprentice."

Mason Contr's Asso. of Rochester, N.Y., and Bricklayers', Plasterers', and Stonemasons' Union, 1910.

Eligibility: "The sons of the employers shall be exempt from the terms of this provision." "Graduates of colleges, universities, or technical schools of collegiate rank may be employed as apprentices though exceeding twenty-one years of age."

Candidates: "Candidates for apprenticeship may be em-

ployed at —— wages not to exceed —— months to prove aptitude, without being enrolled as apprentices."

6. *Management:* Some of the problems of management which are most likely to require determination in collective bargaining are: whether or not "unfair" material is to be debarred, whether or not restrictions are to be placed on output or upon the use of machinery, what the status of the foreman is to be, and what privileges are to be accorded to union officers at the works.

No restrictions: "Subject to the special provisions of this agreement, the employers shall retain and have full power to manage and control their own business and the conduct of their employees in connection therewith, and to make reasonable rules and regulations not inconsistent with the provisions of this agreement relating to the management thereof, and to the hiring, conduct, duties, and dismissal of persons in their employment." — *New Zealand clause.*

No restrictions on materials: "No restrictions shall be enforced as to union or non-union made material, except that prison-made material shall not be used."

Restricted materials: "The company agrees to provide only union materials to be worked upon in the following cases, ——, except that in case union material shall be unavailable, non-union material may be provided upon proof of the fact."

No restrictions on work and machinery: "No restrictions shall be placed upon the amount of work a man shall perform during working hours, nor shall restrictions be placed upon the installation of machinery or the work the same shall do."

Restricted machinery: "The use of the long stroke pneumatic riveting hammer shall be abolished on stay-bolts, and such hammer where used shall always be manned by two boiler-makers. All overhead work will be abolished with the long stroke hammer."

New York Cent. and Hudson River R.R., and Internat. Brotherhood of Boilermakers, 1900.

Status of foremen: "The foremen shall in all matters be the agents of the employer solely." "If a foreman be a member of a union he shall not be subject to the rules of his union, nor shall any fine be assessed upon him by his union, while he is acting as foreman."

Access for union officers: "The company agrees that the business agent of the union shall have access to the works at all times during the working hours, but shall not be allowed to interfere with, give orders to, or delay the men on the work during said hours."

7. *Arbitration:* A prime purpose of collective bargaining contracts is to avoid strikes and lockouts. An essential part of such contracts has to do, therefore, with the procedure to be followed in case of disagreements.

Arbitration: "All disagreements arising between the parties hereto, shall be referred by either party for settlement, to a board of three arbitrators, one selected by each of the parties to the controversy, and the third by the two so selected. Decisions of the Board of Arbitration shall be final and binding on all parties to the controversy."

Elec. Contrs., Rochester, N.Y., and Local Union of Internat. Brotherhood of Elec. Workers, 1910.

Sympathetic strikes: "There shall be no sympathetic strike for any cause whatsoever during the life of this agreement."

Mason Builders' Asso., and Employing Plasterers' Asso. of Buffalo, N.Y., and Plasterers' Union, 1910.

Strikes: "It is further mutually covenanted and agreed that during the continuance of this agreement there shall not be any strikes whatsoever or lockouts declared or permitted by either party hereto, except in sympathy with local trades, and in conformity with Section 4, Article 4, of the Constitution

of the I. B. E. W., of the present date, but that all controversies shall be submitted to arbitration."

Elec. Contrs., Rochester, N.Y., and
Local Union of I. B. E. W., 1910.

8. *Outside work:* Clauses with reference to outside work are always prohibitive.

No outside work on the premises: "While on the premises, no employee shall engage in any other than the employer's business."

No outside work after hours: "No ——, while in employment, shall do or assist in doing any ——— work, save for his employer, for payment, profit, or reward, after ordinary working hours, or on Sundays or holidays."

9. *Layoffs, discharges, and clearance letters:* Clauses on these subjects aim to avoid sudden or sweeping layoffs, to establish the right to notice before the termination of the labor contract, and to provide employees with written evidence of an honorable discharge.

Layoffs: "Should it be necessary to reduce time, the working time to be reduced to 8 hours; if further reduction is necessary, to 7 hours; if still further reduction is necessary, to be divided equally among the men as far as practicable."

American Locomotive Co., and
Internat. Brotherhood of Blacksmiths
and Helpers, 1910.

Notice: "Any member holding a regular place, and desiring to quit work, must give notice to the manufacturer, and then work five consecutive days afterward in his regular place. Manufacturers desiring to discharge members must give them the same notice with the same rights."

Glass Bottle Blowers' Natl. Agreement, 1910.

Clearance or service letter: "Men shall, if they so desire, upon leaving the service, be given a letter stating the nature

and time of service, and reason for leaving the same. Said letter to be given within ten days."

Boston and Maine R.R., and Conductors and Trainmen, 1910.

10. *Renewal of agreement:* In providing for the renewal of agreements, collective bargaining contracts often prescribe in detail the time and manner in which negotiations with reference to changes shall pass back and forth between the two contracting parties. Automatic renewal is usually provided for, when no changes are proposed by either party.

Automatic renewal: "This agreement shall be operative for ——— years from ———, and if no notice in writing of alteration or change shall be made by either party on or before ———. Then it shall be deemed extended for the further period of —— years."

Elec. Contrs., Rochester, N.Y., and Internat. Brotherhood of Elec. Workers, 1910.

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CHAPTER XI

FATIGUE

Labor, in the economic sense, may be defined as the exertion of man's physical and mental powers in the production of goods and service. When we consider the results of labor we say that, if one man in a day produces 100 units of goods, and another 200 units, the latter has performed twice as much labor as the former. Physiologically considered, labor is an activity which destroys tissue cells and produces poisonous waste matter in the system. Considering the effect of the process upon the laborer, the man with 200 units of product may have destroyed four times as many tissue cells as the man with 100 units if his greater output is primarily the result of greater effort. On the other hand, the more productive worker may not have destroyed as many cells as the other if his large product is chiefly the sign of greater talent and facility. The law of increase of the physiological cost of labor diverges widely from the law of increase of economic results. Fatigue is not proportional to results but to the energy exerted. Much of this energy may be wasted. When physical processes are not guided by adequate mental conceptions, roundabout and awkward movements result which produce high fatigue per unit of product. A process which is imperfectly understood, at which the worker struggles mentally, and over which he worries as he works, will mean much fatigue. In all work, whether mental or physical, native aptitude, training, and the facility of habit are highly important as means of reducing fatigue. Of purely mental calculations, Professor Thorndike says, "Greater achievement

per hour means less, and much less, fatigue per hour."[1] A woolen manufacturer reporting to the Tariff Board on the causes of the difference of output of weavers said: "The good weaver never seems to be doing anything; the poor weaver always appears to be hard at work. The good weaver is quietly on the alert for things to happen; the poor weaver is always fussing around to catch up after they happen; consequently the good weaver not only produces more work but better work than the poor one."[2] Another manufacturer said: "It is not a question of quick motions. One of the best weavers we have is a man of very slow, almost sluggish motions. One of the poorest we ever had was a nervous, quick-motioned man. The first made every move count; the second made three unnecessary moves to one that was useful. We believe the same types will be found anywhere in any line of work."[3]

Effort and performance. — It has been found that, as the work of an individual proceeds, there is, at the beginning, a brief introductory period of tuning-up, during which effort becomes increasingly easy and agreeable, while production increases. Thereafter production mounts more slowly toward the maximum, without material change of sensation. A period of some duration then occurs in which conditions are fairly uniform. Decline at first proceeds slowly, and then more and more rapidly, as pleasure fades, and effort, strain, and finally pain, make their appearance in consciousness. At first increasing slowly, these uncomfortable sensations intensify themselves more and more rapidly until, at length, the essence of the task becomes largely the putting forth of the energy of will required to combat them. When we say that a man is "working on his nerve," we recognize that his danger is one of nervous rather than muscular disorganization. At last, effort becomes intolerable, exhaustion is complete, and work ceases.

[1] Edw. L. Thorndike, Mental Fatigue, Journ. of Ed. Psych., Vol. 2, p. 69.

[2] Report of the Tariff Board on Schedule K, Washington, D. C., 1912, Vol. 4, p. 1074.

[3] *Ibid.*, p. 1073.

Recovery. — From moderate fatigue, recovery is rapid and complete, the replacement being with stronger tissue, so that power is increased by use. From great fatigue, recovery is slow and, as age increases, less and less complete. The continuance of labor, after strain makes its appearance, causes a destruction of muscular and brain cells which increases more rapidly than output, and so disproportionally lengthens the period required for recuperation.

Wholesome fatigue. — All degrees of fatigue are by no means evil. The world is far from the point where fatigue, even pronounced fatigue, can be entirely banished from industry. And if it were at such a point, it would signify that the working classes had come at last into the same plight as those aristocratic families of whom Galsworthy speaks in The Patrician, who are "compelled to devise adventure lest they lose belief in their own strength." Many people are mentally and muscularly flabby, and need the quickening influence of vigorous effort to improve the physical metabolism, to act as an alterative to the tissues, and to break up the disintegrating habit of mind wandering. By persistence in the affirmation of one's purpose, and by bravery in self-discipline, one may discover that there is a great difference between mere apathy or ennui and real fatigue. One may find that minor degrees of fatigue can be put to flight by concentration of attention and enthusiasm. And when true fatigue is attained, if it is properly limited, it will be found to have its value in the purchase of rest, content, self-respect, and a later increase of power. Ex-President Eliot has said, "There is pleasure in exertion, even when it is pushed to the point of fatigue, as many a sportsman knows; and this pleasure is in good measure independent of the attainment of any practical end. There is pleasure in mere struggle, so it be not hopeless, and in overcoming resistance, obstacles, and hardships." [1]

[1] Chas. W. Eliot, The Durable Satisfactions of Life, N. Y., 1910, pp. 33–34.

Overstrain. — Passing beyond that reasonable fatigue which acts as a moral and physical therapeutic agency, it must be recognized that there is a point in labor where the exertion becomes too costly for the results achieved — too costly for the worker, too costly for the employer, too costly for society. This may be called the point of overstrain. Trèves of Turin has defined overstrain as "Work done in a state of exertion where there is a more or less marked and persistent disproportion between the usefulness of the work in itself, and in the worker's estimate, on the one hand; and the amount of energy and will power expended on it, on the other hand." [1] Remembering that it is uneconomic to sacrifice a greater good for a lesser one, it must be a rule of economics that labor should cease at the point where society begins to suffer a greater loss through the breakdown of the laborer than the gain resulting from the product of his exertion.

Incomplete recovery. — Recuperation is a process extending through time. The point of quitting must, therefore, depend upon the period which can be devoted to recovery. If the worker is so fatigued in any task period that at the beginning of the next period he has not fully recovered, a deficit is produced which is compounded from period to period. Such a schedule can only be justified by the immediate prospect of a longer recuperation interval, which will restore the equilibrium. We compound fatigue from task to task, and diminish power throughout the working day as shown in Figure 30. And we permit this incomplete recovery because of the near prospect of the overnight rest. Again, we compound fatigue more or less commonly from day to day throughout the week in view of the week-end recuperation. (See Figure 31.) Saturday night dissipation, and Sunday stupor or ill temper, are signs that the schedule of the worker's week unduly lowers his resistance. It is safer and more profitable for all concerned

[1] Ermudung durch Berufsarbeit, Fourteenth Intern. Cong. of Hygiene and Demography.

to limit the exhaustion of the worker to that from which he will be entirely recovered by the beginning of work the next morning. To compound fatigue for periods longer than a

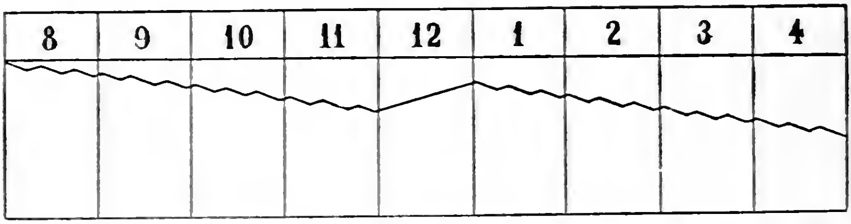


Fig. 30. Compounding of Fatigue Throughout the Work Day

week, counting for recuperation upon the annual vacation, or some future slack season, is highly dangerous. It is to run the risk of being caught in the ominous chain of events, the

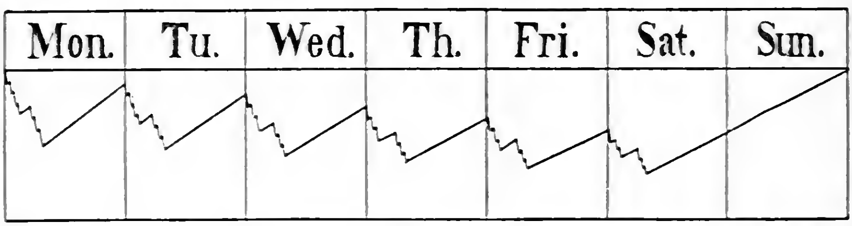


Fig. 31. The Compounding of Fatigue throughout the Week

elements of which are overexhaustion, lowered resistance, specific disease, and death.

Signs of overstrain. — Are there any signs by which we may determine, for practical purposes, when the limits of wholesome fatigue are being exceeded in any specific case? In the identification of pronounced temporary physical and nervous exhaustion there is no great difficulty. The muscular strength is diminished, the eyelids and facial muscles are relaxed, focusing of the eyes is difficult, tactile sensibility is diminished, the enunciation is poor or incoherent, reaction time or the period between sense impression and response is increased, and all the movements are awkward and inadequate. The

attention wanders, there is partial loss of memory, standards are relaxed, and cruder methods long outgrown reappear.[1] With blundering work there is an increase of accidents,[2] while indifference, which testifies to mental repose already begun,

[1] Hartness says, very aptly, "It is not well to try any new thought on a physically tired man." And he illustrates the progressive deterioration of methods incident to growing fatigue, as follows: "Suppose we take two men exactly alike in all respects, with exactly the same knowledge of work to be done, and let them together undertake to dig a ditch, or repair or adjust an intricate machine, or any other kind of work. Let one of the men get in an awkward position to shovel earth or pull a wrench and become a trifle fatigued, either by the physical strain or the worry of the work, and let the other take a less strenuous part in the undertaking. We will find that one has been changed into a progressive and the other into a conservative. The one who is tired from the strenuous part of the work cannot see why the other should suggest digging around a boulder instead of lifting it out of the ditch bodily, or why it may not be necessary to dismantle the whole machine in order to discover the fault. He cannot tolerate any suggestion of a new method of working. It is actually easier for him to do the work by the more laborious but 'habit' method."—Human Factor in Works Management, pp. 50–51.

[2] The accidents reported in Illinois in one year to the State Factory Inspector, are given by Bogardus as follows:

Hour	Number
7– 7 : 59	79
8– 8 : 59	150
9– 9 : 59	193
10–10 : 59	246
11–11 : 59	257
12–12 : 59	49
1– 1 : 59	111
2– 2 : 59	156
3– 3 : 59	227
4– 4 : 59	260
5– 5 : 59	145

When it is remembered that the small number of accidents reported between 12 and 12 : 59, and between 5 and 5 : 59, is caused by the small number of persons employed at those hours, the effect of fatigue is apparent.—E. S. Bogardus, The Relation of Fatigue to Industrial Accidents, Am. Journ. of Sociology, Oct. 1911, p. 512.

or bad temper and a feverish pace, which indicate toxic irritation, reveal the abnormal state of affairs.

The signs of accumulated fatigue are more difficult to recognize, because they have to do largely with nervous exhaustion, because they creep on gradually, and because they may involve an entire industrial group in a collective drift away from normal. Neurasthenia betrays itself chiefly by nervous irritability and the unusually prompt appearance of exhaustion following effort. To these signs may be added, as occasional indications, disorders of the special senses, tremor of the fingers when held in tension, a drooping eyelid, palpitation of the heart, and nervous dyspepsia.

Speed. — The fatigue caused in accomplishing a given physical effect is a function of the speed of performance. This may be seen in the difference between the result of walking a block and of running a block. It is not a simple function, however, for exceedingly slow speeds involve a large expenditure of effort for the result achieved, because of the energy which is absorbed in maintaining a posture. In general, as speed increases fatigue is more than proportionally increased.

The speed standard which is involved in the ordinary labor contract is an extremely vague conception expressed by the phrase "a fair honest pace." The actual pace which results from the equilibrium established between the employer's foremanizing and the employee's soldiering differs from shop to shop, and is sometimes spoken of as "the habit of the shop."

Ideally this pace should be full of snap, and expressive of healthy energy, bringing with the accomplishment a glow, and preparing the way for true repose. It should be enough of a trial of powers to hold the attention from vague wandering, and to stimulate the mind to conceive better methods. It should be such that the worker's conscience can be clear, and that he can spurn the humiliation of speeding up under the eye of the boss, and of soldiering when his back is turned. Only by such a pace can men take their talents out of the napkin,

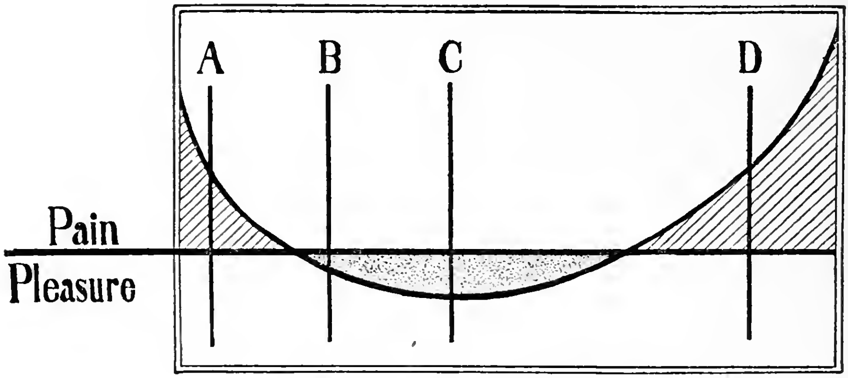
and obtain the "usury," which is increased strength derived from use.

On the other hand, the proper pace is entirely different from the fastest speed in which a task can be done. The latter is of interest in college games, but is not applicable in industry, except in such rare emergencies as fighting a fire or a flood. We have just defined the maximum economic speed in terms of the overnight recuperative process. It may be defined in terms of maximum life performance. Mr. F. W. Taylor has said, "It must be distinctly understood that, in referring to the possibilities of a first-class man, the writer does not mean what he can do when on a spurt, or when he is overtaxing himself, but what a good man can keep up for a long term of years without injury to his health, and become happier and thrive under." [1] Colomb, the physicist of Metz, has given a rule, albeit somewhat vague. He says the speed under load should not exceed one-third of the maximum speed of movements without load. All work-speed standards are subject to an indefinite deduction in view of the energy it is fair for a worker to reserve for his life interests outside of working hours.

In Figure 32, an attempt is made to characterize various speeds of performance in terms of pleasure and pain. The chart is offered merely as a general scheme of relationships. Very slow speeds are irksome (see the left-hand portion of the chart). Extremely fast speeds involve painful stress (see the right-hand portion of the chart). There is a middle ground of speed at which work may be long continued with pleasure. If on this graphic base, representing speed in relation to sensation, we indicate the different paces, it seems fair to say that the pace of soldiering, "A," is painful to a healthy worker, who is adequately adapted to his work by talent and training, and who possesses normal ambition. The average or "good honest" pace, "B," is not unpleasant, but it does not possess the thrill

[1] Hearings before the H. of R. Sp. Com. on The Taylor and Other Systems of Shop Management, Washington, D. C., 1912, II, p. 928.

of first-class achievement. The optimum pace, "C," may be identified as practically the "standard" pace aimed at by scientific management. With these economic paces, the maximum possible pace, "D," which characterizes the brief spurts of effort of competitive athletics, has nothing whatever to do.



Speed of Performance

A = Pace of soldiering
B = "Good honest" days work
C = "Standard" pace of scientific management
D = Maximum pace of athletics

Fig. 32. The Paces of Working

Stress. — Speed disintegrates itself into stress and frequency. By stress is here meant, not overstrain or the consciousness of unwholesome fatigue, but simply the degree of intensity of effort. The German economist Herkner has described the safe physiological limits of stress as follows: "Energetic muscular work makes extra work for the heart, lungs, and digestion, that is easily estimated. If, for instance, the pulse rate exceeds 50–60 per cent of its rate when at rest — if it is over 140, and if after 10 minutes' rest it has not yet fallen to normal, we have before us an injurious degree of fatigue. Respiration should not exceed the rate existing in a state of

rest by more than 75 per cent, and after a fifteen minutes' pause for rest it should not remain higher than 30 per cent above normal. Elevation of the body temperature to 39° or 40° centigrade (Fahrenheit 103°–104°) is unquestionably very harmful." [1]

Intermittency. — The physicist Maschek has proposed the rule that the time occupied in strenuous endeavor should not greatly exceed one-third of the twenty-four hours. This looks suspiciously like our old friend, "Eight hours for work, eight hours for play, and eight hours for rest." At all events, it is of little use, for it does not explain what continuity of exertion is contemplated during the eight hours; nor does the word "strenuous" give an accurate idea as to stress. Tables have been prepared by some of the leaders of scientific management showing what proportion of the working day should be under load, for different kinds of labor, but these tables have not yet been made public. Mr. Taylor tells us in The Principles of Scientific Management, "It is possible for the workman to be under load for only a definite percentage of the day. For example, when pig iron is being handled (each pig weighing 92 pounds), a first-class workman can only be under load 43 per cent of the day. He must be entirely free from load during 57 per cent of the day. And, as the load becomes lighter, the percentage of the day in which the man can remain under load increases. So that, if the workman is handling a half-pig, weighing 46 pounds, he can then be under load 58 per cent of the day, and only has to rest during 42 per cent. As the weight grows lighter, the man can remain under load during a larger and larger percentage of the day." [2]

When a high-grade performance is aimed at, there must be careful control of the factor of intermittency, or of the schedule of work and rest periods, if the danger of overfatigue is to be avoided. The operation of the schedule must be close enough

[1] Article Arbeitszeit, in Conrad's Handwörterbuch der Staatswissenschaften, Second Edition.

[2] Pages 57–58.

to check the worker on the minute from unduly prolonging his exertion. To illustrate the fineness of control already being practised in some establishments, a couple of instances may be given. Mr. C. E. Knoeppel started with workmen who, at their own gait, had been producing 16 pieces per hour. By establishing a 25 minute working period and a 5 minute rest period, he obtained 18 pieces. By changing to 17 minutes of work and 3 minutes of rest the output rose to 22 pieces per hour. Finally, by arranging a 10 minute work period and a 2 minute rest period, production became 25 pieces.[1] In another case where a record of driving 1,600 rivets per day was obtained, the previous performance having been 600 per day, Mr. H. F. Stimpson established rest periods of 2 minutes between each 10 rivets, thus devoting 320 minutes, or 5 hours and 20 minutes out of the 10 hour day to rest, and employing a schedule of $1\frac{3}{4}$ minutes of work and 2 minutes of rest.[2]

Administration and fatigue. — As the laws of fatigue become more accurately established through scientific investigation, industrial managers will be held to closer account by public opinion. What is already known is sufficient to demonstrate the fact that the regulation of the pace is too complicated a matter to be left in the hands of the operative. Speed, stress, and intermittence are compounded in infinite variety in different kinds of work. If high records of production are to be attained with safety, these variables must be under scientific control. Pace-making has always been recognized as an important factor in athletics, where brief tests are made with contestants who are in the elastic period of youth. It is much more important when the object is to determine the stroke of the nation's industry, and to set a pace which shall be wholesome as the habit of a lifetime.

The difficulty of detecting the signs of accumulated fatigue

[1] The Psychology and Ethics of Wage Payment, p. 9.

[2] Hearings before the H. of R. Sp. Com. on The Taylor and Other Systems of Shop Management, Washington, D. C., 1912, I, pp. 663–664.

at an early stage makes advisable the establishment of two policies. The first is that the task should be kept well within the limits of safety, just as in the use of machinery the stresses employed are kept well within the elastic limit of materials. The second policy is that, just as in engineering practice where it is impossible to observe the effect of repeated stresses upon equipment such as the hooks of cranes or the links of hoisting chains the parts are periodically annealed to restore their physical properties, so workers to whom the first-class-man standard is applied should be kept in physical tone and nervous poise by frequent vacations, and by the provision of adequate means of daily recreation.

Pace-making as a managerial function. — The laborer knows his feelings, no doubt, but he often does not know what they signify with respect to fatigue, any more than he does with reference to specific disease. He can no more expect to attain a high performance at his own pace with safety, than an amateur athlete can expect, without coaching, to pace himself correctly for a mile run. Unregulated piece work is known to be a fertile cause of physical exhaustion and neurasthenia among certain groups of wage earners. Under good management, exceptional performance will only be attempted after the conditions of the task have been subject to the minute analysis of motion study and time study, after the proposed exertion has been carefully figured on a horse-power basis by competent engineers, and after the operatives have been selected on the basis of fitness for the task. The workman should be taught the exact rhythm or sequence of work and rest periods, for his own safety. Excess performance should be investigated even more promptly and thoroughly than deficit performance, in order to prevent the injury of valuable men.

When we say that pace-making is a managerial function we do not intend at all to say that it is a capitalistic privilege. There is a distinction. Like many other supervisory functions pace-

making is a part of that newly established art of administration which, if it is ever to become a complete success, must be in the hands of a profession with distinctive professional ideals standing between labor and capital, and aiming to combine the factors of production in a just balance of interests. This art of administration is something more profound than the current art of getting rich or of earning big dividends on capital stock.

Fatigue and the design of equipment. — So long as administrators have created the conditions under which it has been more troublesome and more dangerous and less profitable for the workman to call attention to the conditions which interfere with production than to retard the pace by slipping in secret recuperation periods throughout the day, just so long soldiering has served to hide from the management a world of badly planned processes. Likewise, soldiering has covered with a mantle of secrecy the bad design of machinery. If a wrongly placed lever has called for more fatigue than the laborer could regularly absorb at the pace which the demonstrator used for a brief test, there has been the opportunity of interposing unnecessary stoppages when the head of the boss was turned. Thus the machine has continued to seem the acme of perfection to its builders although, for mysterious reasons, the users have never achieved the expected results. It is quite possible for the minds of operatives to be full of the knowledge of defective processes and imperfect equipment, but for the management never to get access to this stock of knowledge, because it has never devised a plan of administration and a system of rewards which made frankness safe between management and men with reference to the factor of fatigue.

Pace-making must be scientific. — To guess at the proper pace will no longer do. It has been tried; and when the attempt has been made to overdrive, the response of the workman has been soldiering; a deceit which has spread in the ranks like an infectious disease, to the immense impoverishment of

all factors in industry.[1] The natural response to an unreasonable task is feigned labor. Stupid managers have argued that, since day wages are calculated for a continuous stretch of time, labor should be continuous throughout the day. But all human energy is intermittent, and rest periods have been imperative. The laborer has been obliged to get them by deceit.

When management becomes scientific we may hope to get rid of this deception; for soldiering is a miserable hybrid thing, neither work nor rest, and without merit, except as a weapon of warfare, either in the world of work or in that of recreation. When a man works he should accomplish results commensurate with the value of his time. When he rests he should relax tired muscles, and cease the strain of attending, and take 100 per cent rest.

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[1] For some descriptions of the state of affairs see Hearings of the H. of R. Sp. Com. on The Taylor and Other Systems of Shop Management, Washington, D. C., 1912, I, pp. 82–83; II, pp. 843, 1107; III, p. 1266.

CHAPTER XII

THE MEASUREMENT OF WAGE FACTORS

The wage problem is the endeavor of employers and employees to establish a ratio between money and services, and by so doing bring the value scale and the effort scale into connection with each other.

A part of the difficulty of doing this lies in the lack of adequate information in the hands of all parties interested, as to the general conditions which at any time determine the relative scarcity or plethora of human productive power in any market. Among these conditions are the demand for commodities, production costs taken in relation with prices to determine profits, the supply of capital available for investment, the supply of managerial ability, the openness of the field of enterprise, and the soundness of conditions on the money market and the security market. Some conditions on the side of labor supply are the number of operatives who possess the talent and training necessary for the work under consideration, the rate of inflow of immigration, the effect of educational agencies, and the opportunities for self-employment. Until information is more intelligently gathered and classified on these matters than at present, the labor market is bound to present a great divergence of opinion as to the value of labor, and consequently to involve a constant turmoil of higgling and bargaining in determining the exact price, between these wide limits, at which purchase and sale transactions will take place.

There is still another reason why the labor market achieves only a bungling approximation to a true equilibrium, and this

is that in any specific case the exact labor capacity offered is uncertain, and the nature of the task which the employer will present is equally uncertain. Of the laborer the age, sex, and nationality, the last employer, and a fragment of the experience is known. The constitutional vigor and state of health some employers are now determining. But there is little knowledge as to neatness, accuracy, dexterity, speed, and dependability; as to education, general and vocational, and experience in the craft; as to outside causes of worry; and as to originality, loyalty, and the other qualities which fit the possessor for higher positions. On the other hand, there is the utmost variety in the nature of tasks: and employers are only beginning to formulate the requirements necessary for success in various kinds of work. Equally great is the variety of conditions which surrounds the worker while rendering his service. The employer cannot intelligently define the stress, speed, and intermittency of effort expected, nor the responsibility and nervous tension which will rest upon the worker. The comfort or discomfort of the working quarters, the foremanizing methods, the policy of promotion, and the permanency of the job are not under close control. Everywhere there is lack of accurate calculation of these essential factors, and lack of standardization of them. With such a mass of indeterminate elements the wage-setting process can hardly be other than a wrangle, like that of a coolie buying a cabbage in a Chinese market, or a diplomatic game like the purchase of a rug in an Oriental bazaar. Because of such conditions great inequalities in wage rates exist without adequate reason; neither party to a wage transaction can be sure it has received justice, there is much suspicion, relationships are strained, and much energy is diverted from production to carry on a warfare both secret and outspoken.

The application of science. — In the interest of a fair wage it is greatly to be desired that science should be applied to the measurement of these indeterminate or crudely calculated

factors of the labor problem. Every element which can be reduced to measurement, and every functional relation which can be defined with clearness, serves by so much to reduce the tangled mass, and bring the wage level to the point where it accurately balances supply and demand. A wage based upon measurements will respond chiefly to the permanent conditions and general tendencies, and will be little disturbed by the mere strategy of bargaining. Such a wage will be relatively stable, for the variations of fundamental conditions are less than the fluctuations of ignorant opinion as to those conditions. It is certainly to the laborer's interest to get the labor-valuing process into the hands of persons of scientific temper, and get scientific agencies applied to the calculation of wages. It may be responded that the laborer hopes to establish a process of collective bargaining. To this it can be answered that collective bargaining is mass action. It suffers from the limitation of democracy in that it can only act well upon simple issues. Any scientific process which will standardize labor conditions, and will dress away a host of collateral issues by giving them indisputably fair measurement, and will thus leave clear the central point of the wage question, will fit that question to be acted upon by the slow and cumbersome processes of collective action.

It is apparent that the jealousy existing between capital and labor offers an obstruction to the progress of the scientific study of the factors involved in fixing the price of labor or in determining the efficiency of labor. It is greatly to be desired that non-partisan agencies should be created to carry forward this line of research. The laboratories of engineering schools might take part: the aid of The Federal Bureau of Standards might be invoked.

As to the influence which the public conscience can exert upon the wage levels, we must remember that only clear ideas propagate themselves easily from mind to mind. Any standardization of elements which will make it possible to take the

labor problem to pieces, and decide one element of it at a time, will make for a more intelligent and forceful public opinion.

Standardization of conditions. — The first step, then, toward a rational wage is the exact definition of the conditions under which labor is to be performed. Definition can only be exact when conditions are under control, that is to say, are standardized. The process of standardization, described elsewhere in this book, plays the same part as an aid to economic analysis that laboratory control does to investigation in the experimental sciences.

Standardization of the laborer. — The next step toward a scientific wage is the standardization of the laborer. The individualization of labor records by the better class of employers is now providing a means of studying the performance of employees in sufficient detail to lay bare the conditions essential to efficiency. The invention of motion study and time study provides industry at last with an instrument of precision comparable with the microscope in its relation to the biological sciences. And now vocational education and vocational guidance, laying hold of various physiological and psychological tests, promise to give to employees, at the threshold of industrial life, a wiser guidance than has heretofore been possible. In so far as this provides a cleaner grouping of men into classes according to talent, it will make possible greater definiteness in standards of competency. These changes will inaugurate within industrial establishments a sifting process, the object of which will be to shake incompetents down and raise the talented up, until each operative finds the level upon which he is a first-class man.

The first-class-man standard. — The new ideal of workmanship is being expressed as the standard of "the first-class man." To some persons this suggests a standard based upon a pace-maker; but in reality it is the only plan by which the influence of the pace-maker can be eliminated. If ten persons be chosen at random for a quarter-mile race, the records will

involve a great spread of performance, and the better men will shame the poorer ones. Such a record may be represented by Figure 33.

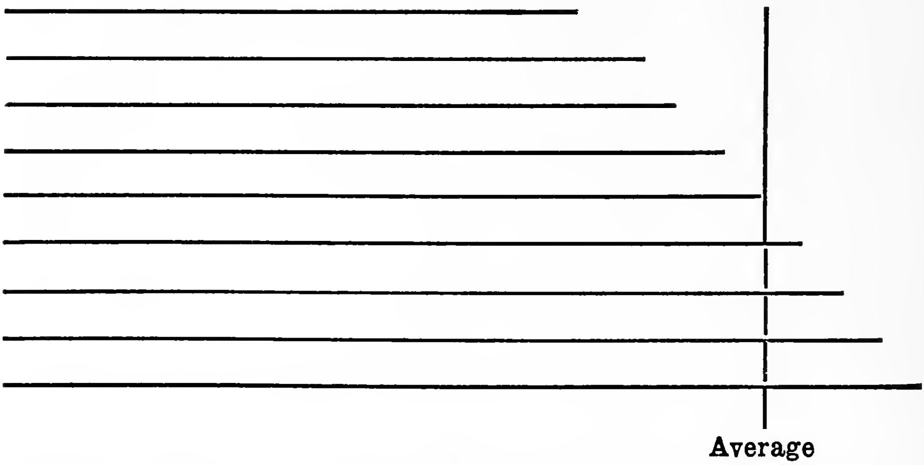

Fig. 33. Record of the Performance of Unselected Individuals

But if ten men be carefully selected, and given adequate training, their performance will differ by but a few seconds, so that the average performance will gain in significance as the figure which adequately sums up the record. This may be illustrated by Figure 34.

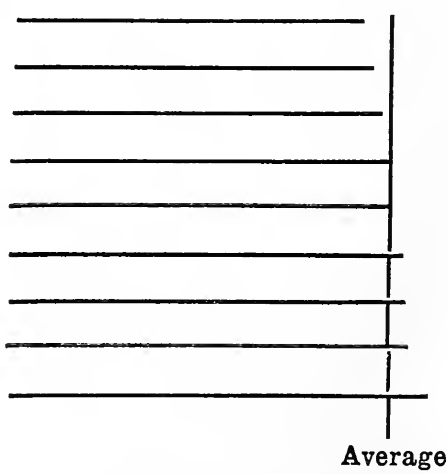

Fig. 34. Record of the Performance of Selected Individuals

By the comparison of the two diagrams it can be seen that the performance of the exceptionally fast man is much less significant in the second case than in the first. In mixed and untrained ranks, the first-class man is a thoroughbred among misfits. In the hands of a drive management he may be made a destructive instrument by spurring others to efforts which are dangerous for them, because of their lack of training or aptitude. But if the standard of selection is that each man must be a first-class man for his place, the influence of the pace-maker at once disappears. He is among his equals, and his lead is reduced to a negligible quantity; if not negligible in sport where but one is victor, and the record is the chief thing, at least negligible in economics, where the aggregate output is the important factor. To an intelligent management the significance of the exceptional man is not at all with reference to pace, but entirely with reference to superiority of method. The exceptional man as a pace-maker is a destroyer; but as a teacher he becomes a helpful leader.

Standardization of the rate of performance. — When the conditions of labor have been standardized, and workmen of adequate native powers and sufficient training have been installed, the third step in the scientific determination of the wage rate is to fix the proper pace or rate of performance. If we have to do with distinct units of work, such as the machining of a casting, the rate will be expressed as a task time; but if work proceeds without distinct subdivisions into tasks, as in calking a ship, or in transcribing dictation onto a typewriter, the rate will be stated in terms of quantity per hour or per day, as 350 feet of calking per day, or 100 square inches of typewritten work per hour.

What the workman knows. — Where shall information as to the proper rate of performance be obtained? From the workman, who has, perhaps, spent ten or twenty years at his trade? The suggestion sounds reasonable. Let us see. At the Watertown Arsenal, when scientific methods were being

introduced, the time-study expert set 24 minutes as the proper time for a certain job, and 40 minutes as the time at which the bonus should begin. There was a great protest in the moulding room. As a concession, the bonus time was changed to 50 minutes, or the average time the moulders had been taking for the job. So long as the foundry gang could control the situation 50 minutes, quite exactly, was always taken for the job. But when, at length, a new man came into the shop, it was found that 20 minutes was ample time for him. Thereafter, all the moulders did the job in 20 minutes without difficulty.[1] At the Rock Island Arsenal, Lieut.-Col. F. E. Hobbs relates the case of an employee who fabricated 5 pieces of a certain article in 24 hours, when a piece-rate was being fixed. Not long afterwards the same man was producing 5 pieces in $16\frac{1}{2}$ hours. Nevertheless, when a proper system of management was established, eight different employees working at various times on the same article, were able to average 400 pieces in 14 hours.[2] Maj. D. M. King, of the same Arsenal, reports the case of a man on day work who filed from 15 to 17 pieces per day, but who, on piece work, turned out regularly from 45 to 47 pieces daily. At the Mare Island Navy Yard, Mr. H. A. Evans, U. S. Naval Constructor, found the calkers doing from 80 to 100 feet per day. After a piece-work figure was set, the men were able, with perfect ease, to do from 380 to 400 feet per day.[3]

These illustrations, which might be multiplied indefinitely, show how little is known by the workman as to the possibilities of industry. An unorganized shop has as many opinions as to what constitutes a fair pace as there are workmen. An organized shop has one opinion, and that is that there should be solidarity of action in defending the chosen pace. Mr. Taylor has said, "It is the rarest possible case that either the

[1] Hearings before the H. of R. Sp. Com. on The Taylor and Other Systems of Shop Management, Washington, D. C., 1912, III, p. 1266.

[2] *Ibid.*, II, p. 843.

[3] *Ibid.*, III, p. 1867.

management or the men know what a really first-class man is capable of doing if he goes at it with the best implement, with proper appliances, and with determination and a will to do everything that he can do. What I maintain, and feel absolutely sure of, is that the full and proper solution of the wages question — as to which system shall be employed, and the amount of compensation to be paid — lies in a study of how much each man should do, or could do, or ought to do. It is this study, this accurate study of how long he ought to take to do a job of work, which is of so much greater importance than the adoption of any one system of paying men that the latter sinks almost out of sight, or ought to sink out of sight. I wish to repeat that, with the knowledge of how long a job should take, even the day-work plan of paying, which is perhaps, in many cases, the least satisfactory, will produce much larger results than will any of the other systems without this knowledge."

Time study. — The standard method of determining the proper time for a task is called time study. The first step in time study consists in the accurate measurement, with proper instruments of precision, of the times required for the performance of the elementary human movements of which any job is composed. Time study does not concern itself with machine speeds; those are controlled by engineering calculations. It has to do with human movements, or handling times. Nor does it concern itself at first with the total elapsed time of any completed job. Although the ultimate object is a figure representing the proper total time for a task, the method of getting it is not to record the beginning and ending times of a series of acts, as a judge at a race-track would do. If we measure a series *en bloc* we get a time which cannot be compared with that of any other series unless that series is composed of identical units. If there are differences between two series, and we attempt to allow for them, we find ourselves at once considering component elements, and trying to calculate the effect of the presence or absence of certain elements. But

we can only successfully allow for differences in elements after having studied the times of elements. Tasks are infinite in variety, but the elementary movements of which they are composed are comparatively few in number. If we attempt the direct measurement of complete tasks our judgment will be lost in infinite variety; but if we observe the times of the elements, the small number of typical movements makes it possible to attain sound judgment. It is because workmen measure only total elapsed time that, even though they may have been engaged for a lifetime upon a certain class of work, they rarely arrive at an intelligent knowledge of how long a task should take under altered conditions. The time-study expert, on the other hand, can quickly analyze work which is unfamiliar to him, just as a chemist can analyze a substance which he has never seen before. In this difference of power is illustrated the importance of the first step in the scientific method, which was described in Chapter I.[1]

A sufficient series of measurements of each elementary operation must be taken to make possible a sound opinion as to what the best time is. On this point, Mr. Dwight V. Merrick, who is an experienced time-study expert, says, "If the elementary operations require a reasonably long time and the work is being done at a uniform rate, a few complete observations will suffice. On the other hand, if the elementary operations are very short and from any cause successive pieces are not produced at a uniform rate, a great many observations may be required.[2]

An observation sheet containing elementary times, the minimum task time, and the standard or bonus time, is here reproduced.

Composition of the minimum time. — Giving attention to the composition of the observation sheet, we find that on the

[1] Pages 5 and 6.

[2] Making Instruction Cards from Time Studies, Iron Age, March 11, 1915, p. 561.

WAGE FACTORS

OBSERVATION SHEET

Observer's name.............. *Workman's name*.................... *Piece*......

	Detail of Observation	Individual Times (In minutes and hundredths)					Minimum times
		1	2	3	4	5	
1	Put board in place..............	.04	.03	.05	.05	.06	.03
2	Place pattern on board..........	.03	.05	.03	.04	.05	.03
3	Place drag in position...........	.10	.08	.11	.14	.12	.08
4	Sprinkle parting on pattern......	.04	.07	.04	.03	.05	.03
5	Shovel on facing sand...........	.06	.02	.03	.04	.03	.02
6	Ram.........................	.20	.14	.22	.21	.19	.14
7	Fill drag with backing sand......	.07	.13	.05	.07	.08	.05
8	Ram.........................	.29	.26	.24	.24	.17	.17
9	Strike off......................	.13	.15	.15	.08	.08	.08
10	Place bottom board.............	.08	.07	.09	.09	.13	.07
11	Roll drag over..................	.09	.12	.11	.12	.16	.09
12	Remove board...................	.03	.02	.03	.03	.04	.02
13	Sprinkle parting on pattern......	.09	.06	.03	.08	.09	.03
14	Place cope in position...........	.08	.08	.09	.12	.13	.08
15	Place gates....................	.08	.10	.13	.11	.09	.08
16	Shovel in facing sand...........	.07	.08	.02	.09	.10	.02
17	Ram.........................	.18	.17	.18	.18	.19	.14
18	Fill cope with backing sand......	.12	.12	.14	.13	.10	.10
19	Ram.........................	.30	.25	.25	.20	.25	.20
20	Strike off......................	.12	.18	.20	.20	.17	.12
21	Draw gate.....................	.10	.10	.15	.16	.11	.10
22	Remove cope...................	.15	.15	.06	.09	.10	.06
23	Draw pattern...................	.60	.58	.63	.62	.65	.58
24	Patch mould....................	.30	.29	.29	.30	.28	.28
25	Open gate.....................	.20	.20	.20	.21	.23	.20
26	Close mould....................	.12	.15	.12	.11	.12	.11
27	Remove to floor and remove flask	.18	.25	.29	.28	.30	.18

Total minimum time..	3.09
Allowance (60 per cent)..	1.85
Time it should take to set one mould	4.94
To earn premium, work must be done in time and $\frac{2}{3}$ or	8.23

SAMPLE OF A TIME STUDY SHEET

different occasions when the workman did the task he took for the operation entitled "Put board in place" the following fractions of a minute, .04, .03, .05, .05, .06, respectively. The record chosen for the minimum task time is the lowest one or .03. In line 2, likewise, we find that the records are .03, .05, .03, .04, .05, and that the element taken for the minimum task time is .03. These minimum times for each element are added together to form the minimum task time for the job as a whole.

It may be asked why the lowest record is taken rather than some other record. For any series of measurements there are several figures, any one of which may be chosen to represent the series. We can take the median time, or the time which will divide the series into two parts, a higher and a lower, each containing an equal number of observations. And we might justify ourselves in this on the ground that each individual case makes its contribution toward the discovery of the proper time. Or we can take the mode of the series, that is to say, the record which appears most frequently; and do so on the theory that the record found most often represents the normal equilibrium into which the usual, permanent, and legitimate factors of the case tend to fall. Still another possible choice is the average time, or the time which will be given if the sum of times of the series be divided by the number of the observations. Such a figure is more complex than the others as it gives weight to the number of instances, and also to the quantitative variation.

The time which is usually chosen by efficiency experts is the minimum time. This figure is assumed to represent a capable man working under the best conditions; a state of things proper to hold up as the ideal. By taking the lowest records a great advantage in method is attained, namely, that one question is taken up for decision at a time. The lowest time is assumed to be pure, net performance; as simple and homogeneous a thing as is available, and a measurement as free as possible from indefinite elements representing rest,

incompetency, unavoidable interruptions, etc. If we begin with such a time, we can then, in proper turn, consider the making of allowance for all the retarding causes which prevent the attainment of the minimum.

Allowance. — Allowance is added to the minimum task time to produce the standard or proper task time. In the allowance it is intended to take care of rest periods, and the personal requirements of the employee, unavoidable variations in the quality of materials or in the condition of equipment, time lost in changing tools, time required to change from one type of work process to another, the moving of raw and completed stock (if such work is not done for the operative by move men), the lower performance of the later hours of the day, and the fact that all the men who will be retained as satisfactory for a job are not equal to the best man. In short, allowance is intended to cover all immeasurable and unstandardizable elements of performance which influence the time. It is a lump sum to cover all time-influencing factors which it is not yet possible to submit to scientific measurement. It is, therefore, the most difficult item to determine in the whole process of time setting.

The amount of the allowance should differ with the nature of the work, with the rest intervals necessary, and with the degree of control attained over power, equipment, tools, etc. At the Tabor Manufacturing Company in Philadelphia, the allowance on handling time varies from 30 to 80 per cent. Mr. Taylor, who aimed at high performance, and desired only the best men, and who determined task times with great care, found an allowance of from 20 to 27 per cent satisfactory.

Time study and soldiering. — By the use of motion study and time study soldiering can be detected and measured. Soldiering is composed either of false motions, or of retards on certain processes, or of idle periods inserted at definite points, or of a more or less uniform slowing down of all movements. False motions can be detected by motion study,

which examines the purpose and value of each element in the process. Idle periods, and retards located at specific points, are revealed by a comparison of the times taken by the same operator on different occasions, since voluntary retards can seldom be inserted twice alike. Attempts at uniform retardation are at once revealed by the comparison of the elementary times of different men.

The records of motion study and time study. — The statistics of elementary studies form an objective and permanent record available for reference and appeal. As Mr. Hollis Godfrey has said, "When a task has been studied, and set down, there is a written statement of fact, scientifically determined, which is fair, both to employer and to employee, if it has been scientifically done. Such a recorded task serves as a basis for fair dealing on both sides. In an unknown and unrecorded task you leave altogether too much power in the hands of one party or the other, commonly in the hands of the employer. With a scientifically studied and determined task, which has been recorded, both sides meet on an equal plane."[1] When to the specifications of the task are added records of the individual performance of the workman, there is produced something to which the employee can refer in appeal against arbitrary discharge, or the spleen of any individual official. In case of a shut-down, a capable man has, in such records, specific proof, accurate and convincing, as to his capacity, and as to the result he can guarantee to another employer.

Opposition to time study. — The making of time studies has been vigorously opposed by the representatives of organized labor. It is urged that the only man who is in a position to say how long a job should take, or what are the necessary or unnecessary elements of it, is the man who has gained experience by doing the job. This statement appears to carry force, for every one realizes that expertness grows out of first-hand

[1] Hearings before the H. of R. Sp. Com. on the Taylor and Other Systems of Shop Management, Washington, D. C., 1912, III, p. 1841.

contact with the conditions of one's problem. But there are here two kinds of experience. The operative is engaged in performance: time setting is an entirely different matter, and one possessing principles and a technique of its own of sufficient distinctness and complexity to demand the attention of an expert. The objection is an instance of the fallacy of "ambiguous middle," involving two meanings of the word "experience." It is, in effect, the assertion that the man engaged in routine performance is equipped by that experience for the administrative functions which control that performance. If we admit such an idea as this we should have to argue that the farmer who has "experience" with the soil in plowing it understands soil analysis better than the soil chemist, that the mechanic who has "experience" with a casting by machining it knows the problem of design of the mechanism of which the casting is a part better than the engineer, that the man who "experiences" pain understands the meaning of his symptoms better than the physician.

A second objection is that when a time-study expert stands by an operative with a stop-watch, and records his every movement or pause, the process is humiliating — in fact a kind of slavery — and is a proceeding which implies distrust. By way of explanation, it should be said that, after a sufficient record of elementary times has been made in a plant, there is very little time study required, because total times are compiled from the records of the elements. If a new job appears the only time study required is with reference to the new elements which it may contain: no attention needs to be given to the elements which are common to other jobs and which have been already measured.

As for the sense of humiliation, it must be said that this is something depending entirely upon the purpose or ultimate aim, rather than upon the process. The college student is not humiliated by the questions of the instructor; the injured man is not humiliated by the operations of the surgeon. And

this is so because the purpose in each of these cases is a beneficent one. Humiliation springs from reduction of condition, or the manifestation of disesteem; but time study aims at improvement of process, higher wages, and general welfare. It proclaims that a new fine art exists in each of the crafts; and affirms the worker's ability to achieve a better record. If the purpose of a management is to share the results of greater efficiency in a just manner with its men, humiliation should vanish as this purpose becomes understood in the ranks. If the purpose is not fair, the fault lies, not in the process, but in the ultimate aim.

A third objection is that time study puts a strain upon operatives, and produces nervousness. This is partly answered by what has gone before. In so far as there is nervous strain in a force of men which understands and approves the purpose of attaining higher efficiency, it may either signify that the new régime is not being installed tactfully and intelligently, or that certain individual workmen are hypersensitive. It must be remembered, however, that stress and effort are an inevitable price exacted by nature for all high excellence. This is not something to complain of, if the achievement is worth while; but it is something for an administration to deal with according to the laws of fatigue.

There is ground for suspicion that the objection to time study is merely a matter of tactics, and that the true ground of opposition of organized labor to scientific management is its aim of paying men according to individual performance. This principle of remuneration is in opposition to the union procedure of establishing a single rate of wages for a trade in a locality. The policy of uniting on a single rate has advantages as a campaign measure, for it sinks individual interests and promotes solidarity of action. It has the misfortune, however, to oppose the introduction of scientific agencies for measuring the value of labor, to oppose the process of differentiation and specialization which is an element in all progress, and to repudiate the

principle that each man should be rewarded according to his performance, — a principle everywhere dominant in nature and one to which all the professions and occupations are subject, except organized labor and monopolistic management, — a principle which is especially vital in a country depending upon a régime of individual initiative.

BIBLIOGRAPHY

See the close of Ch. XIV.

CHAPTER XIII

THE OLDER WAGE SYSTEMS

Day Wages, Piece Rates, Profit Sharing, and the Sliding Scale

From the point of view of modern methods of administration, we may divide the systems used for calculating wages into three classes: (*a*) those which antedate the modern movement, including the day wage, the piece rate, profit sharing, and the sliding scale; (*b*) the bonus systems which do not require standardized conditions nor scientific time setting, represented by the Halsey system in this country and the Rowan system in Great Britain; (*c*) those bonus systems in which thoroughly controlled conditions and accurate time setting is a cardinal point, embracing the Taylor differential piece rate, the Gantt task and bonus system, and the Emerson efficiency wage.

The day rate. — The oldest of the wage systems is the one which offers the workman a given sum for a fixed period of his time. The rate may be quoted as so much per hour, day, or week. The limits of a given rate are, at the bottom, the point of inefficiency which brings discharge, and at the top, the point of excellence which is rewarded by promotion. Within these limits, the day rate pays exclusively for the workman's time, taking no account of the quality or quantity of work done. So long, therefore, as the workman remains safely within the limits, he is in a passive state, except as he may be energized by the dictates of conscience, or by loyalty to his employer, or by the praise or blame of the foreman. On the

other hand, the employer is awakened to activity by this system of payment. Any additional productive effort which he is able to secure from his force by means of the careful selection of individuals, the division of labor, the introducton of machinery, or by drive tactics of foremanizing, is clear gain to him. Any slowing down of the pace creates a loss which he alone must bear.

The chart of the day rate. — In designing a chart to illustrate the effect of an increase or decrease in the rate of produc-

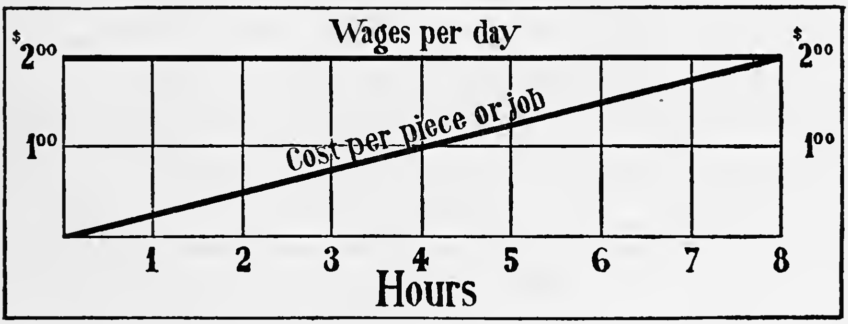

Fig. 35. Wages and Costs under the Day Rate
Wages per day. Direct-labor cost per job or per piece.

tion under the various wage systems, it is to be remembered that there are two things of primary importance. The chief stimulus which moves the employee to exert himself is the amount of wages it is possible to earn in a day. The chief object of the employer is to lessen the direct labor cost per job or per unit of product. The series of charts here introduced illustrate for each wage system the effect of the accomplishment of the task in different lengths of time upon these two things — the total earnings of the day, and the unit cost for direct labor.

Advantages. — I. The day-wage system adjusts itself fairly well to the realities of the financial position of the employee. Workmen who, by reason of the trade they follow or the type of work they perform, find themselves in a given social class,

tend to live in a similar way, and to incur like expenditures as consumers. Within any particular group having a common standard of life there exist considerable differences of individual producing capacity; but in so far as the individual workers or their families are contented with the class they are in, they will be more anxious that the wage should be sufficient to keep them in the class, than that it should exactly measure individual productive effort. Where discontent becomes prevalent, it is likely to be the result of the work of organizations whose scope conforms to some one of the divisions of the wage-earning class, and to consist in the conviction that wages should be raised for the class generally, rather than that talented individuals in the class should be given remuneration above the rest. In so far, therefore, as the wage earner is content to retain the standard of life of his class, he is satisfied with wages which meet the requirements of this class standard, regardless, within considerable limits, of the energy and ability he may have to put into his work. So long as there is no question of change of class, expenses appear to be chiefly a function of time — such and such bills to be met each week or month. The wages to cover these expenses will then appear, likewise, to be chiefly a function of time — so much per day or per week.

II. The day rate favors careful work, for it permits the workman to express his ideals of craftsmanship and his pleasure in a perfect product, without loss to himself. The man who builds a house by the day, instead of by the contract, never fails to mention the fact when he offers the house for sale. Even excessive care as to the quality of work will not be distasteful to the day worker and his companions, for it will be recognized that this is one form of "nursing the job."

III. The trade unions favor the day rate, because it creates a solidarity of interest within each wage group. Exceptional men endeavor to raise the standard wage as the only means of improving their own condition. The average man is satisfied

with a wage which is fair for him. Those who are below the average give their ardent support to the standard, for it is a means of rewarding them beyond their desert.

IV. The calculations involved in this method of paying are simple. The payroll can be made up, class by class, directly from the attendance record.

V. If it is desired to make day wages respond with a reasonable degree of flexibility to individual performance, it can be done by breaking up the traditional craft groups into a sufficient number of wage classes, each class being given a different rate of pay. There will thus be created a promotion and demotion scale, up and down which men may be moved according to their value.

VI. By dividing each kind of work into short and clear-cut tasks production may be stimulated, and even, perhaps, standardized for a time, if the performance aimed at is commensurate with the wages paid. And this will follow because the time of the completion of a task is an advantageous juncture for raising the question of efficiency, so that, if such junctures are made clear and frequent, thoughts of promotion or discharge and of self-testing will be potent in the employee's mind.

Disadvantages. — I. The principal objection to the day-rate system is that it represses the superior man. Mr. F. W. Taylor has said, "The effect of this system is distinctly demoralizing and levelling; even the ambitious men soon conclude that since there is no profit to them in working hard, the best thing for them to do is to work just as little as they can and still keep their position. And under these conditions the invariable tendency is to drag them all down even below the level of the medium." [1] Thus latent talent tends either to hide itself, and so not secure the necessary training and authority to render greater service, or else it finds vent in antagonistic forms of activity.

[1] F. W. Taylor, A Piece-Rate System, Trans. of Am. Soc. of Mech. Eng., June 1895, Vol. 16, No. 647, p. 861.

II. It is, of course, no argument against the day-wage system to say that it forces the best men into the unions; for the better the leaders of the labor organizations are, the better the policies will be. But a system which produces in exceptional men a sense of personal injury is sowing dragon's teeth. If the employer's wage policy teaches the men that administrative necessity requires the underpaying of exceptional men for the sake of the convenience of applying a standard wage, it prepares the way for the union argument that the strategy of the labor campaign necessitates applying the standard wage to men who are below the average.

III. The flexibility which is to be obtained under the day-rate system by the creation of numerous wage classes (point V above) is more theoretical than practical. Speaking from a long practical experience, Mr. H. L. Gantt says, "The employer usually pays but one rate of wages to one class of workmen, because, as a rule, he has no means of gauging the amount of work each man does. It is exceedingly difficult to keep an exact record of what each of a number of men does each day; and even if he had such records, the difficulty of comparing them would be very great, unless the work done by each man was of the same nature, and done under the same conditions. The result is that he keeps no individual records, but usually treats all workmen of a class as equals, and pays them the same wage. There may be 20 per cent who are very much more efficient than the rest, but he has no way of distinguishing them from the others with any degree of certainty; hence he declines to increase any wages, or makes the difference in wages insignificant as compared to the difference in efficiency." [1]

IV. The standardization of performance (point VI above) cannot be made self-enforcing when the day rate is used. The only *vis a tergo* to keep the men above ordinary performance is the energy and attention of the management. The essence of this defect, in so far as the wage plan is concerned,

[1] Work, Wages, and Profits, N. Y., 1910, p. 52.

is the lack of an adequately graduated scale of rewards and penalties suitable for creating a smoothly operating adjustment between effort and reward. Such rewards and penalties as exist are too extreme for frequent application. Promotion is looked upon by the employer as a more or less permanent commitment to higher wages. Demotion is more disgrace than most workmen will endure, especially if it involves dropping a man out of a class which is recognized as such among the operatives. Discharge is expensive and demoralizing.

V. Since the pace at which the management can drive the men is a variable one, the wages become an uncertain element of cost.

Piece rates. — The second of the long-standing plans of paying labor is to set a price upon a job or a unit of product, and pay that sum regardless (within promotion and demotion limits) of the time taken to accomplish the work. As piece rates have originated in the majority of cases in a process of changing over from day rates, it has been natural, in setting them, to take into account the previous day-wage standards, and the previous rates of performance. In most cases rates have been fixed at such a point that an average performance would yield the current wages of the trade. Even with a standard as low as this, the employer has been ensured a saving, because workmen who are below the average in output are paid less than the previous day wage. In some cases the rates have been based upon the idea of a "fair" or a "good honest" day's work, and the time of a single selected man, or the average time of a number of selected men, has been taken to represent this conception. There is still in this standard an indirect recognition of the current day wage, and of the prevailing pace of working. A piece rate must rest upon a judgment as to proper working times and proper daily earnings. The straight piece-work system provides, however, no regular and normal means of revising either of these judgments, and so provides no normal method of changing the rate.

Under piece work the employee makes all the gain or loss of his own time. If he shortens the time used, or if any improvement introduced by the employer shortens the time,

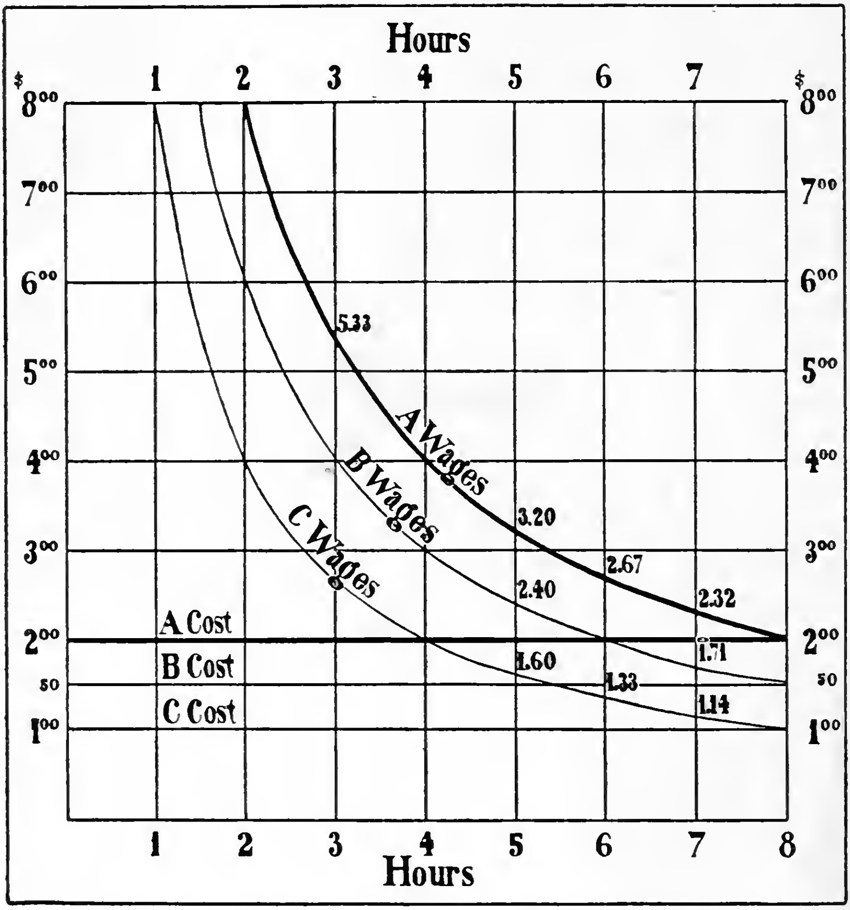

Fig. 36. Wages and Costs under Piece Rates

Wages per day.
Direct-labor costs per piece or job.
A = Standard time 8 hours.
B = Standard time 6 hours.
C = Standard time 4 hours.

he receives no less for the job finished, and he gains time in which to make extra earnings at the same rate. If he takes a long period, his remuneration may fall below day wages without

check. By this the workman is put under responsibility, and stimulated to take the initiative. He is aroused to demand materials free from defect. He becomes impatient with the delays of service departments, and outspoken in denunciation of breakdowns. There is thus a tendency for managerial duties to pass over from the employer to the employee, and for shop administration to drift along in the wake of the force. The extra earnings made by men under the piece-rate system may, therefore, be looked upon as partly the addition of the wages of management to the wages of labor.

One of the factors of unit cost not shown in Figure 36 requires a word of explanation. While the employee makes all the gain or loss of his own time, the employer gains by rapid performance from the fact that the factory burden to be charged to each piece or job is decreased. On the basis of cost and capitalization data of the Census of 1910, with the addition of certain reasonable assumptions,[1] it may be said that unit manufacturing costs will decline under piece work approximately as follows:

Time taken,		8 hours (standard)	.....	Percentage of cost,			100.
"	"	6 "	....	"	"	"	95
"	"	4 "	....	"	"	"	90
"	"	2 "	....	"	"	"	85
"	"	1 hour	....	"	"	"	82.5

Employers favor piece rates where soldiering is difficult to detect, as in moulding; where speed is unusually important, as in railroad repair shops; where work is done away from the employer's place of business, as among the glove makers of

[1] Invested capital to yield 8 per cent; salaries to be increased at 6 hours by 5 per cent, at 4 hours by 10 per cent, at 2 hours by 20 per cent, and at 1 hour by 25 per cent; depreciation on buildings 3 per cent; depreciation on machinery, tools, and equipment to be at 8 hours 5 per cent, at 6 hours 6 per cent, at 4 hours 7.5 per cent, at 2 hours 9 per cent, and at 1 hour 10 per cent.

Gloversville, N. Y.; and where the distinctness of tasks favors the calculation of a job price, as in the collar factories of Troy, N. Y., and the hat factories of Danbury, Conn.

Advantages. — I. The chief advantage of this system is that the reserve productive power of those persons capable of better than the average performance is given a market. An outlet is provided for it, and it becomes free to assert itself to the advantage of the possessor. If the day wage accommodates itself to the requirements of those employees who are satisfied with their standard of life and their status generally, the piece-rate system attracts those who are dissatisfied and wish to apply their energies to raise themselves into a higher economic class. As the talented draw ahead of the average under this system, emulation permeates down the line and awakens the energies of all. Not only is output increased, but methods are overhauled, for the thought of the worker is set loose as well as his hand. The U. S. Bureau of Labor has estimated the usual increase in production, when piece rates are introduced, at 25 per cent.[1]

II. The records of increased performance constitute the chief argument which is being prepared for the shortening of the labor day. To reduce the hours from 10 to 8, and maintain output, would require an increase in the rate of production of 25 per cent. The response recorded by the Bureau of Labor shows that such an increase can be attained on the average, where the inducement is offered.

III. The direct labor cost per unit of product or per job becomes a fixed amount, reliable for use in cost calculations of a preliminary or prospective character.

Disadvantages. — I. The plan of giving to the wage earner all the saving in the time of production to be made in an establishment from and after a certain date, is bound eventually to break down and require revision. Such a revision may be forced quickly by an unexpected spurt of workmen. If they

[1] Eleventh Special Report, Washington, 1904, p. 17.

easily attain a high rate of performance, and thereby reveal how far below the best — indeed, how unworthy and absurd — was the "average" or "fair" performance used as the initial basis of calculation, the employer will believe that he has trapped himself. When, under such conditions, the workmen get wages far above the customary incomes of men of equal ability, general opinion will condemn the rates as unnecessary, and as unfair. But if revision of the rate is not compelled by the workman's response, the general evolution of methods of production, including the introduction of improved machinery and superior processes of working, will eventually bring it about. Under average conditions, with piece work, about 88 per cent of the benefit of all improvements affecting the rate of production accrues to labor, and 12 per cent to management. The strike of 1892, at the plants of the Carnegie Steel Company, was due to the cutting of obsolete piece rates. Before this strike was called, some of the laborers were getting larger wages than the superintendents, owing to improved appliances which had greatly increased production since the rates were first set. As Mr. Halsey says, "Cutting the piece price is simply killing the goose that lays the golden egg. Nevertheless, the goose must be killed. Without it the employer will continue to pay extravagantly for his work; with it he will stifle the rising ambition of his men." [1]

Although the rates have to be cut, the act of cutting them is looked upon as a declaration of war. The employees consider it the violation of an agreement. The conclusion in many cases is that the management introduced the first rates as a bait to induce the men to reveal how much they could do, while the second rates constitute the springing of the trap which is designed to hold the men for the new standards of working, while not allowing wages to exceed a certain moderate excess over day wages. The response of the workman to such

[1] F. A. Halsey, The Premium Plan of Paying for Labor, Am. Soc. of Mech. Eng. Trans., Vol. 12 (1891), p. 756.

a policy is to oppose the introduction of piece rates, but where they are established, to soldier as much as possible while the rates are being set, in order to get a long time base, and then to control the pace so that the wages earned will never rise above the point which is thought to be the maximum the employer will allow. At that rate performance is pegged, and held, against all efforts of the management to increase it further. The piece-work system, after such a series of events, settles down into an antagonism of interest between management and men, which is as clearly defined and enduring as any contest of policy possible under day rates.

II. High speeds are hard on machinery and equipment, especially where the machine speeds are not scientifically set, and where the mechanical conditions are not kept under competent control.

III. By analogy, high rates of performance are hard on the men. As was pointed out in the discussion of fatigue, high performance may be costly in human energy, unless the management possesses the ability to enforce standards conformable to the laws of fatigue. All extreme exponents are dangerous in the hands of ordinary management.

IV. The tendency of piece rates is toward volume at the expense of quality, since the wage follows the tally of pieces finished.

V. Straight piece work does not guarantee day wages. The discouragement of low earnings, therefore, besets the learner.

Department bonuses. — A group bonus has been devised by Cadbury Brothers Ltd. of Bourneville, England. A bonus is given on the output of a department, the fund being divided into shares. This gives an inducement to the employees to keep the number of workers in the department down to the lowest point, since any increase in the number diminishes each individual share, by increasing the number of shares. The wages and bonuses are so adjusted by Cadbury Brothers Ltd., that a good department will usually receive 75 per cent

of its remuneration in time wages, and 25 per cent in bonuses.[1]

Profit sharing. — Profit sharing is not a complete system of wage payment, but an adjunct which may be added to any of the fundamental plans which do not sufficiently awaken the energies of the employees. The usual plan of profit sharing is to calculate the profits of an establishment for a fiscal period — either a year or a half-year — and to pay a fixed proportion of them to the employees in the form of a percentage added to wages. Profits may be defined, for the purpose of this distribution, as that portion of gross earnings which remains after the usual operating expenses have been deducted, and after interest on borrowed money and a reasonable remuneration on the proprietor's capital has been taken out. This sum is divided between the proprietors and the employees. The division may be into equal parts — dollar for dollar — or it may be in such a proportion as to give the same percentage of dividend on the capital and on the total sum paid out in wages during the period. The latter plan would divide the fund, in the average case, in the ratio of 4 to 1. Still a different system is to calculate separately the profit made on each job, and assign a fixed percentage of it to the men engaged on that job.

When the total share to be received by labor has been decided upon, the next step is to distribute it to the individual workman. This individual distribution is almost always on the basis of the wages earned. It is very common, however, to exclude from participation those persons who have been employed for less than a year. The remainder of the employees may be grouped somewhat into classes, in such a way that the dividend is greatest for those of longest term of service. The bonus so calculated may be paid out in cash, or it may be credited on the books of the company in payment for stock

[1] Edw. Cadbury, Experiments in Industrial Organization, N. Y., 1912, pp. 144–145.

which is to be issued when fully paid, or it may be placed in a fund to provide old-age pensions or some other form of deferred benefit.

The experience of the leading profit-sharing concerns in this country seems to indicate that the plan is only successful when coupled with a stock-sharing or stock-purchasing arrangement. The Proctor and Gamble Company in 1903 abandoned the cash distribution of profits to employees, and instituted a plan which makes profit sharing an element in a stock-purchasing plan. Any employee of that corporation may subscribe for an amount of stock equal at its market value to his annual wages or salary. He must pay $2\frac{1}{2}$ per cent down and 4 per cent annually thereafter for his stock; the corporation aids him, however, by advancing him the unpaid portion of his shares at 3 per cent, and by crediting him annually for the first five years with 12 per cent of his yearly wages, for the second five years with 15 per cent of his wages, and thereafter with 18 per cent. After 5 years of stock owning the employee's stock-purchasing power is increased 25 per cent, after 10 years 50 per cent, while every increase in wages brings a proportional increase of stock-purchasing power.

Profit sharing does not choose as a basis for the distribution of the extra gains any measure of the individual efficiency of persons. It passes by such individual records and fixes upon an item — profits — which expresses the prosperity of the business as a whole. In so doing it aims at team work, and the creation of a general spirit of loyalty, rather than at exceptional individual achievements. The decisive point of the plan, economically speaking, is the question whether or not the response made by the employees in the form of greater care and energy and regularity in work, will make up for the extra share divided out to them, so that the dividend received by capital will not be diminished, but may even be increased.

Similar plans. — It is to be noticed that profit sharing involves a measure of joint risk taking. It is, therefore,

distinct from any plan for distributing a bonus to employees in the form of a fixed percentage added to the wages, and given regardless of the profits earned by the employer. It is also distinct from the plan of the Ford Motor Company of Detroit of giving a high wage to those employees who attain certain moral and economic standards. Of the Ford plan, Mr. Boyd Fisher, Vice-President of the Detroit Executives' Club, has said, "The Ford plan is not true profit sharing, because what the workers receive is proportional neither to the extent of the profits of the business, nor to their contribution of individual efficiency. Higher wages are given solely upon condition that the worker adopt a proper standard of living, an object that has never before been introduced into profit sharing, and an object that makes the Ford plan a totally different scheme." [1]

Advantages. — I. Profit sharing encourages the negative virtues. It does not very greatly arouse the positive ones. It removes obstructions without stimulating individuals to strenuousness. It makes, therefore, for such results as the economy of materials, the better care of tools, and sound, honest workmanship. A steady condition of moderate industry is rather feebly promoted. Idlers who, under this system, are stealing from their fellows as well as from the management, become unpopular. In general, a willing and teachable attitude of mind comes to prevail, which produces a sound public opinion or "habit of the shop."

II. If the ultimate desire of men employed under profit sharing still remains personal gain, the method of attaining it is made more social than under any of the other wage plans. There is set up a joint aim for management and men, which emphasizes solidarity of interest. The employee is given a glimpse of the proprietor's problems, and a share in them which may somewhat modify his mental attitude.

III. The pecuniary benefits of profit sharing are indiscriminately distributed, descending, as does the rain, upon the just

[1] The Detroiter, Jan. 25, 1915.

and unjust alike. And so the plan is suited for situations where individual contributions cannot be accurately measured. This suggests that profit sharing is a plan which ought to be more at home among salaried men than among wage earners.

Disadvantages. — I. The plan is only appropriate for established and successful businesses which can reasonably anticipate regular profits.

II. The process of calculating the profits abounds in accounting intricacies and arbitrary determinations so that, if the original spirit which inaugurated the system chances to wane, there are opportunities for disguising the earnings. "The workmen have no means of knowing," says Halsey, "if the agreement is carried out. With their exaggerated ideas of the profits of business, the results must be in many cases disappointingly small; and they will doubt the honesty of the division. What is to be done in such a case? Invite the workmen to appoint a committee to examine the books, and report? Most employers will demur at this, and yet without it the employees can have no assurance of good faith; and were it done, what good could result? How many workmen's committees are there who are sufficiently versed in modern accounts to form any idea of the proceeds of the year's business from an examination of the books? In this light the profit-sharing plan is seen to be an agreement between two parties, the first of whom has every temptation and opportunity to cheat the second, while the second has no means of knowing if he has been cheated, and no redress in any case." [1]

III. It is an arbitrary arrangement to couple any part of the income of the workman with the fluctuation of business conditions over which he has no personal control. Profits in a business are due, not only to the capacity of the shop employee or office clerk, but to the supply of capital, the fluctuations of the market, the advantages or disadvantages of the location,

[1] Trans. Am. Soc. Mech. Eng., Vol. 12 (1891), p. 758.

the judgment used in extending credit, and the choice of suitable patterns and qualities of goods to make.

IV. It is an axiom that speculation is unsuited for small investors. Business profits are speculative; and the profit sharer usually has not the financial reserve to enable him to average out fluctuations, and preserve his habits of consumption undisturbed. In his case income and expenditure are direct-connected, so that irregular income tends to derange the entire economic life.

V. The profits of this system are too small, too long postponed, and too little influenced by the effort of an individual to make them an effective motive with the average laborer. "The average workman," says Mr. Taylor, "in order to maintain a rapid pace, should be given the opportunity of measuring his performance against the task set him at frequent intervals. Many men are incapable of looking very far ahead, but if they see a definite opportunity of earning so many cents by working hard for so many minutes, they will avail themselves of it." [1]

VI. The dividends under profit sharing come to be looked upon as a matter of custom and as a right. It is difficult to keep alive the sense of obligation to put forth effort in coöperation with the management to create these extra profits. The lack of any close connection between individual exertion and reward makes the stimulus to extra effort small. The capacity to feel wronged if dividends are withdrawn persists however in undiminished strength.

VII. There is no new way opened by which exceptional individuals can cash in their reserve talents to their own personal advantage.

VIII. In spite of the solidarity at which profit sharing aims, it is opposed by trades unions. The distinction in kinds of solidarity is elucidated by Professor Taussig: "Trade unionism looks to a horizontal division; all the employees in a trade,

[1] F. W. Taylor, Shop Management, N. Y., 1911, p. 84.

scattered in various establishments, are to be united in common action against all the employers. Profit sharing looks to a vertical division; the employer and employees of the single establishment are to be united, working together for the common welfare of their compact group, sharing the gains and perhaps the losses. . . . The unions are opposed to profit sharing, or at least suspicious of it, because it tends to make the workman interested chiefly in the welfare of his immediate fellow-employees, not in that of all workmen of the trade or locality."[1] To the unions, profit sharing is a scheme for giving to the workmen something they have rightly earned, and making it appear as a gift. To them it is often an advertising feature.

Profit sharing for salaried employees. — Work which is paid for by salaries is usually very much less a function of time than that which is paid for by wages. The efficiency of the salaried worker is revealed only when considerable periods of time are taken into account. It is customary, therefore, to calculate salaries in terms of a month or a year instead of in terms of days or weeks. The service paid for by salaries is not capable of as exact measurements, in terms of money, as are wage services, so that the remuneration takes the form of a round number, while increases in it are made by material but infrequent advances from one round number to another.

The staff employee contributes an indefinite share to the final result. Much must be trusted to his ability to work for a distant objective and to feel enthusiasm for an impersonal project. American practice is in the direction of paying administrators high salaries rather than a share of profits. For wage earners it appears to be tending somewhat toward gain-sharing arrangements. It would seem more logical to stimulate staff employees and responsible officers by a share of

[1] F. W. Taussig, Principles of Economics, N. Y., 1911, Vol. II, pp. 303–304.

profits than to make such an offer to wage earners, whose responsibility is more completely bounded by the terms of the specific tasks. The basis of salaries is, and must continue to be, a stipend to insure to the individual the standard of life of his class, and so relieve his mind from financial worries. But, if an addition could be made to this basis, which would vary as the larger problems of the business were well or ill solved, the arrangement would seem to be justified as a recognition of the essential partnership which men of managerial responsibility sustain to capital, arising out of the discretionary element in the duties performed.

Carnegie's plan. — One of the greatest successes ever achieved with profit sharing in American industry was made by Andrew Carnegie in the development of junior executives. The plan, stated in the words of its author, was as follows: "Speaking from experience, we had not gone very far in manufacturing before discovering that perfect management in every department was needed, and that this depended upon the men in charge. Thus began the practice of interesting the young geniuses around us, as they proved their ability to achieve unusual results — the source of big dividends. These received small percentages in the firm, which were credited to them at the actual cash invested, no charge being made for good-will.

"Upon this they were charged interest, and the surplus earned each year beyond this was credited to their account. By the terms of the agreement three-quarters of their colleagues had the right to cancel it, paying the party the sum then to his credit. This provision was meant to meet possible extreme cases of incompatibility of temper, or if the recipient should prove incapable of development, or of enduring prosperity. At death the interest reverted to the firm at book value. The young men were not permitted to assume any financial obligation, and not until their share was fully paid by the profits, and there was no further liability upon it, was it transferred

to them. Thus thoughts of possible loss never prevented concentration upon their daily duties. They were not absorbed in the daily quotations, for the shares were not upon the stock exchange or transferable. This policy resulted in making some forty-odd young partners, a number which was increased at the beginning of each year." [1]

The Bethlehem Company. — The Carnegie traditions are perpetuated, in somewhat altered form, in the bonuses applied to the executives of the Bethlehem Company. There is no single comprehensive plan followed in this establishment, but the endeavor is made to discover for each department some record which will indicate the efficiency, and make a portion of the remuneration of officers, heads of departments, superintendents, salesmen, or workmen vary as the efficiency-index varies. Thus, in a manufacturing department, bonuses may depend upon the amount by which actual conversion costs fall below some set figure; salesmen may be rewarded proportionally to the profits realized on particular orders booked by them; in contract work those responsible for speed will divide the time bonuses earned; in other cases bonuses may vary inversely with the demurrage paid to railroads, or directly with the value of waste materials recovered and sold. It is understood that the president of the Bethlehem Company has a nominal salary of $10,000 but receives a variety of bonuses, the total of which in 1914 amounted to $300,000.

The Sliding Scale. — A sliding scale is a piece-rate plan of paying labor, resulting from collective bargaining, and so adjusting wages that they will rise and fall with the selling price of the materials worked upon. The result of coupling wages and prices together is to bring about a crude sort of profit sharing and loss sharing.

A characteristic scale is as follows:

[1] Andrew Carnegie, The Organization of Manufacturing Industries, (The Making of America,) Edited by Robt. J. La Follette, Vol. III, pp. 273–274.

Puddling Schedule per ton of 2240 lbs.
(For boiling pig iron to make wrought iron)

Wages	When the Price of Bar Iron is
$5.00	1 cent per pound
5.00	1.1 cents " "
5.00	1.2 " " "
5.25	1.3 " " "
5.50	1.4 " " "
5.75	1.5 " " "
6.00	1.6 " " "
6.25	1.7 " " "
6.50	1.8 " " "
6.75	1.9 " " "
7.00	2. " " "

The thought which underlies the plan is that employers should pay well when prices are high, but that, in periods of low prices, employees can better afford to take low wages than have the plants shut down. By adopting an automatic arrangement which makes wages a function of something which is accepted as an index of the employer's ability to pay, the transition from higher to lower levels can be accomplished without strikes, and that from lower to higher wages without lockouts.

The first sliding scale was introduced in England in the iron and steel trade, through the efforts of G. B. Thorneycroft of Wolverhampton, in 1840. In the latter part of the nineteenth century the plan attained considerable extension in the coal and iron trades of Great Britain, but it has now been entirely abandoned in so far as the coal trade is concerned. On the Continent the system has never been introduced. The first American sliding scale was adopted in 1865, through the influence of the Sons of Vulcan, and for the purpose of regulating the wages paid for boiling pig iron. Since that time the system has gradually gained for itself a permanent footing in the basic processes of working iron and steel.

The problem of adopting a sliding scale is, first of all, one of choosing a price base. It is essential to the proper working of the plan that there be some commodity which will serve as a barometer of the financial condition of the industry, as coal of the coal mining industry, pig iron of the blast furnace industry, or billet steel of the steel industry. It is desirable that the product be simple, or at least strictly standardized; be sold upon a highly perfected market, so that individual sale transactions will conform closely to a ruling price, and that sales take place freely without the intervention of expensive and high-pressure selling campaigns.

The second problem is to determine a minimum wage rate and equate it with the minimum price, and to carry this minimum wage unaltered up the price scale, until a point is reached where it is agreed that the employer can pay more than a minimum. Third, above this point a scheme of progression must be worked out which will cause wages to rise with prices to an extent which, on the one hand, will be sufficient to satisfy the unions and lead them to carry out their agreements, but which, on the other hand, will allow profits to increase more rapidly than wages, so that employers will have no inducement to refuse the advances. A wage scale which advances 2 per cent for each 3 to 5 per cent of advance in prices is about the usual thing. As for the administration of a sliding scale, the practice in the United States is for manufacturers, at bimonthly intervals, to communicate to committees of the unions sworn statements of the prices received during the preceding two months. In case of dispute as to facts, access to the employer's books is permitted. Upon the basis of the ascertained prices, wages are fixed for the succeeding two months.

Advantages. — The English Royal Labor Commission of 1894 advanced the following points: "The advantages claimed for this system are (1) that it obviates disputes about wages, at any rate, during fixed periods; (2) that it promotes a feel-

ing of copartnership and common interest between employers and employed; (3) that it enables employers to calculate what will be the cost of production, in wages, for some time ahead, and therefore to enter into long contracts with some feeling of security; (4) that it causes alterations in the rates of wages to take place gradually and by a series of small steps, instead of suddenly and at a bound." [1]

Disadvantages. — I. An annually revised scale provides recurring periods of uncertainty. The difficulty of this has been reduced as far as possible by the non-interruption clause introduced since 1901–1902 into contracts between the Amalgamated Association and the employers. The scale year ends June 14. The new scale is to be presented to employers not later than May 1. An adjustment period extends from May 1 to June 15, followed by a conciliation period from June 15 to July 1. No shut-down or strike is to take place until after July 1.

II. It is inevitable that there should be a speculative element introduced into wages by hitching them to some commodity price. The significance of a sliding scale to each of the parties in the contract depends upon which way that party expects it to slide. If a base rate is set low in anticipation of higher prices, but a season of low prices ensues, there will be suffering among employees. If a scale is set high in depressed times, and a war boom follows, the wages may mount to levels which try the patience of employers.

III. Dissatisfaction has sometimes arisen from the fact that, for a time after current prices have become high, mills still continue to work on contracts previously entered upon at lower prices. This is not completely offset by high-priced contracts holding over into periods of low current prices, for cancellation of contracts is freely practised at such times. A remedy was introduced into the South Wales colliery agreements after 1892, providing that no contract should be taken

[1] Final Report, Secs. 109–115.

into account as determining prices for more than six successive audits of two months each.

IV. No matter how fair an adjustment is given to a sliding scale, industrial changes will, at length, make it out of date, and compel its revision. The general drift of prices, the increase in the cost of some influential raw material, the introduction of new equipment or improved processes, the fluctuation of the labor market, the rise in the cost of living, or the competition of new districts, are but a few of the things which make new equations necessary. In 1865 the boiling scale began at \$4.00 per ton, when wrought iron sold at $2\frac{1}{2}$ cents per pound; in 1905–6 this scale began at \$5.00 when wrought iron sold at 1 cent per pound.

BIBLIOGRAPHY

See the close of Ch. XIV.

CHAPTER XIV

THE NEWER WAGE SYSTEMS

The Halsey, Rowan, Taylor, Gantt, and Emerson Systems

The Halsey premium system. — This system of wage payment is named after F. A. Halsey, being devised by him while he was Superintendent of the Rand Drill Company of Sherbrooke, Canada. The idea of it, expressed in a sentence, is to ascertain the average previous times of doing jobs, and to offer the workmen an agreed percentage of the wages of any portion of this time they may save, in addition to their regular hourly or daily rate for the time taken.

The author of the plan says of his time base, "Time is determined from previous experience." [1] In practice, the average of previous times is taken. He explains that the aim is to be liberal with the time rather than with the premium. It is usual to guarantee that when the time limits are once set for jobs they will not be reduced, unless the method of doing the work is changed. Day wages are guaranteed to those who fail to reach the standard.

To workmen who finish their tasks in less than the allotted time, there is paid, in addition to the hourly wages for the time worked, a proportion of from $\frac{1}{4}$ to $\frac{1}{2}$ of the wages of the time saved. Mr. Halsey indicates that the 50 per cent bonus may be paid if the task is a difficult one which has been scientifically set, but that $33\frac{1}{3}$ per cent is enough when the records of past

[1] The Premium Plan of Paying for Labor, Am. Soc. of Mech. Eng. Trans., Vol. 12 (1891), p. 759.

day work or piece work are used. If, then, a workman who is on an hourly rate of 25 cents has an 8 hour task given to him, and completes it in 6 hours, and the bonus is $\frac{1}{3}$ of the saved time, he will receive —

$$
\begin{array}{lll}
6 \times \$0.25 = & \$1.50, & \text{the hourly rate, and} \\
\frac{1}{3} \times \$0.50 = & \underline{.167,} & \text{the bonus,} \\
\text{Total} \quad = & \$1.667, & \text{which is at the rate}
\end{array}
$$

of $0.278 per hour, or $2.22 per day.

The premium is calculated on each job separately, so that failure on one job does not sacrifice the premium earned on another. Shop conditions are not disturbed. The acceptance of the plan is voluntary with each workman. Regular wages are paid, and the bonuses earned are put in separate envelopes and placed at the disposal of any workmen who will take them. It is rather difficult for labor organizations to find a grievance in a plan which guarantees previous rates of wages, sets previous rates of work as the time base, and merely offers an extra remuneration for extra effort.

The plan differs from day wages in that workmen get extra pay for extra product, and from piece work in that the rate of pay per piece decreases as the amount finished in a given time increases. It has been said that this plan was originated in 1886 by Mr. Henry R. Towne, President of the Yale and Towne Manufacturing Company. The Towne plan divides an establishment into departments and, having determined certain items of prime cost in each department, gives to the men a share in any gain they can make by reducing the labor time, decreasing material waste, or otherwise. The Halsey plan considers time rather than labor cost, carries the bonus calculation down to the separate jobs, and distributes the bonus on the basis of individual performance.

Advantages. — I. The Halsey plan is easy to introduce. It requires no preliminary studies, other than to calculate previous average times, and it calls for no reorganization or

new agencies other than those required to collect the times of current jobs. It adjusts itself to unstandardized conditions and to the ordinary processes of administration.

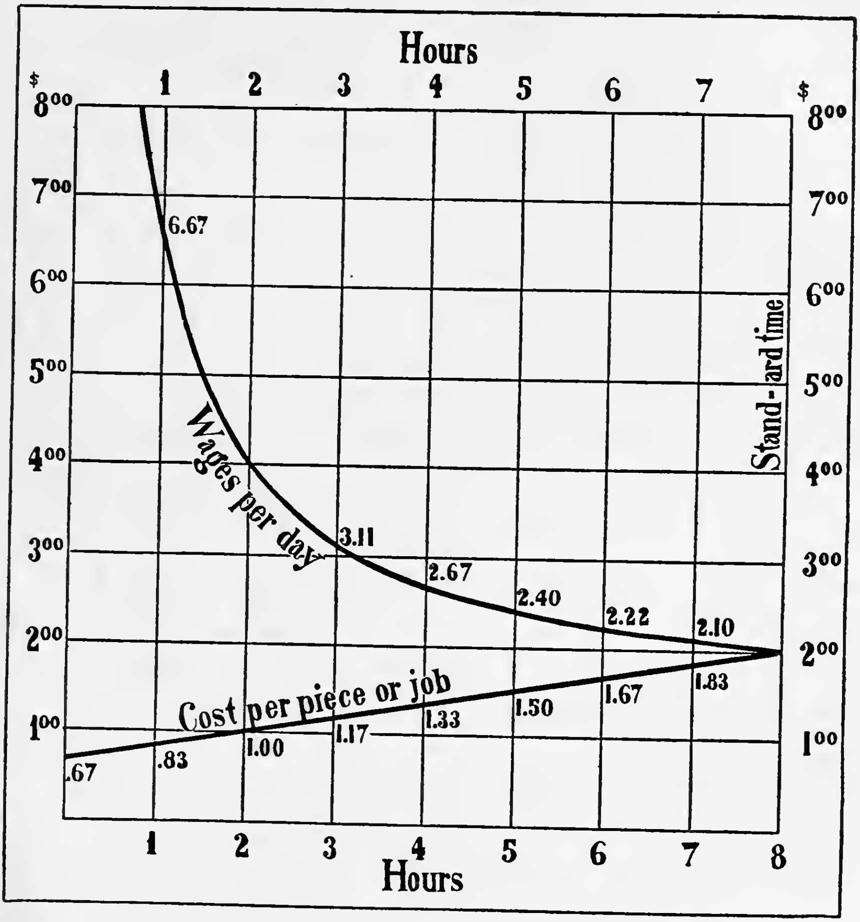

Fig. 37. Wages and Costs under the Halsey Premium Plan

Wages per day.
Direct-labor costs per piece or job.
Standard time 8 hours (previous average time)
Bonus one-third of saved time.

II. A chief merit urged for the plan is that, by dividing the profit of saved time between management and men, it makes for the permanence of the bonus rate. If an unduly liberal

time base be fixed for a job, and if as a consequence a workman makes a great saving in time, only a portion of the saving is given to the workman: an arrangement which prevents wages from being forced up to such high figures as to exhaust the patience of the employer.

III. The psychology of the plan is adroit. If an employee is able to complete in 8 hours ten jobs of a standard time of one hour each, it is obviously the same thing, financially, to offer him 25 cents an hour and $\frac{1}{3}$ of his saved time, as to offer him 25 cents each for the first eight jobs finished in a day, and $8\frac{1}{3}$ cents for each additional job. The psychology of the two propositions is, however, quite different. To save time seems to a workman a process of conservation, a demonstration of his ability, and an achievement in harmony with the hurrying ideals of American life; to produce a greater output seems more like overworking, and glutting the market, and giving his employer something without adequate return.

Disadvantages. — I. If there is not the same motive for soldiering under this plan as under the day rate, there is a greater temptation to it than under piece rates, for under piece rates the workman receives all of the wages of saved time. The unstandardized conditions which the system is based upon, and which it permits to continue undisturbed, give opportunity for this soldiering to be successfully done.

II. Administratively viewed, the policy is one of "putting it up to" the workman. It is, therefore, fundamentally a policy of drift.

III. If the splitting of the saved time ensures the permanence of the rate, it does so at the cost of depriving the workman of a complete energizer. Taking the conditions assumed in the charts, the increase in daily pay offered for reducing the time the first eighth, that is from 8 to 7 hours, is 10 cents under the Halsey plan, and 32.5 cents under piece rates, a difference of 22.5 cents. The reward of reducing the time the much more difficult eighth from 4 to 3 hours, is 44 cents under the

Halsey system, and $1.33 under piece work, a difference of 89 cents.

IV. The fairness of the plan of dividing the profit of saved time between management and men has been called in question. Mr. Harrington Emerson has said, "If there are no improvements by the employer, there is no reason why the employee should not get in full the increased result due to his greater diligence and skill, but if improvement is due to the employer's better equipment there is no justice in giving the employee any part of it." [1] It is only when improvements are made by both parties to the contract in something like the proportions in which the wages of saved time are shared that any scheme of division is sound.

V. The workmen can beat the game by spurting on certain jobs to capture a premium, and soldiering on other jobs to rest up, under the protection of the guarantee of day wages.

The Rowan premium plan. — A somewhat different premium system for sharing saved time has been devised by Mr. James Rowan of David Rowan and Sons, Glasgow, Scotland. This system, like that of Halsey, leaves previous conditions of operation and management undisturbed. Standard times are based on experience. Day wages are guaranteed to those who fail to reach the standard. Like the Halsey system also, the chief aim of the Rowan plan is to insure the permanence of the premium rate, by limiting the earnings a workman can make by unusual saving in time.

Under this plan if a workman reduces the time by a certain percentage, he gets an equal percentage of increase in his hourly rate. If the time is cut 25 per cent, the wages are increased 25 per cent. If a workman whose rate is 25 cents per hour finishes an 8 hour job in 6 hours, saving 25 per cent of the time, he receives the hourly rate for 6 hours or $1.50, plus 25 per cent or $0.375, making the job rate $1.875, and the time rate $0.3125 per hour, or $2.50 per day of 8 hours.

[1] Discussion in Trans. of Am. Soc. of Mech. Eng., Vol. 25 (1903), p. 78.

If the time is cut 50 per cent, the wages are increased 50 per cent, etc.

A formula for the wage has been constructed as follows:

$$\text{Wage} = \text{Wages of time used} + \left\{ \frac{\begin{matrix}\text{Wages of}\\ \text{time saved}\end{matrix}}{\begin{matrix}\text{Wages of}\\ \text{time set}\end{matrix}} \times \begin{matrix}\text{Wages of}\\ \text{time used}\end{matrix} \right\}.$$

This formula is useful only to elucidate one point, namely, that the largest earning it is possible for the employee to make is double the guaranteed wage. And this earning is theoretical, for it is the rate of pay when an infinitesimal of time is taken. In the formula, the expression —

$$\frac{\begin{matrix}\text{Wages of}\\ \text{time saved}\end{matrix}}{\begin{matrix}\text{Wages of}\\ \text{time set}\end{matrix}} \text{ may be stated as } \frac{\begin{matrix}\text{Wages of}\\ \text{time set}\end{matrix} - \begin{matrix}\text{Wages of}\\ \text{time used}\end{matrix}}{\begin{matrix}\text{Wages of}\\ \text{time set}\end{matrix}}$$

As the time used decreases, this fraction tends toward $\frac{\begin{matrix}\text{Wages of}\\ \text{time set}\end{matrix}}{\begin{matrix}\text{Wages of}\\ \text{time set}\end{matrix}}$ or unity. Thus the formula at its most favorable point becomes, $\text{Wages} = \text{Wages of time used} + \left\{ \frac{1}{1} \times \begin{matrix}\text{Wages of}\\ \text{time used}\end{matrix} \right\}$ which is

$$\text{Wages} = \begin{matrix}\text{Wages of}\\ \text{time used}\end{matrix} + \begin{matrix}\text{Wages of}\\ \text{time used}\end{matrix}$$

or twice the hourly rate for the time taken.

The fluctuation of the premium may be seen best by putting the wage elements into the form of a proportion:

$$\begin{matrix}\text{Wages of}\\ \text{time set}\end{matrix} : \begin{matrix}\text{Wages of}\\ \text{time saved}\end{matrix} :: \begin{matrix}\text{Wages of}\\ \text{time used}\end{matrix} : \text{Premium}$$

In the case of a job of 8 hours standard time, and a 25 cent guaranteed hourly rate, the premium for performance in different times becomes,

Time	Wages of time set	Wages of time saved	Wages of time used	Premium
8 hours.........	$2.00	$0.00	$2.00	$0.00
7 "	2.00	0.25	1.75	0.21875
6 "	2.00	0.50	1.50	0.375
5 "	2.00	0.75	1.25	0.46875
4 "	2.00	1.00	1.00	0.50
3 "	2.00	1.25	0.75	0.46875
2 "	2.00	1.50	0.50	0.375
1 "	2.00	1.75	0.25	0.21875
0 "	2.00	2.00	0.00	0.00

The remuneration is self-limiting for, as the percentage of the standard time saved increases, the base — the wages of used time — to which this percentage is applied, in calculating the premium, decreases. The plan is more liberal than the Halsey system in rewarding improvements up to $\frac{2}{3}$ time economy. From that point on it is less liberal. Inasmuch as the improvement of pace achieved by the unaided efforts of the workmen, under various bonus and premium plans, will seldom exceed $\frac{2}{8}$ or $\frac{3}{8}$, this system is, in practice, more liberal than the Halsey system. On the other hand, the self-limiting operation of the premium calculation so reduces the reward for exceptional performance that workmen are not likely to exert themselves greatly. Mr. Barth has called attention to this defect as follows: "The Rowan plan cannot be very successful in inducing a workman to give away the time in which he can do a piece of work, when the time allowance for this is excessive; for it is then so easy for him to earn a substantial increase over his day wages by only moderate exertions that the slightly higher relative increase that further exertions would net him will not appear to be worth his while." [1] If, as it is claimed,

[1] Testimony of Carl G. Barth in Hearings before the H. of R. Sp. Com. on The Taylor and Other Systems of Shop Management, Washington, D. C., 1912, III, p. 1575.

this feature protects the employer from having to pay extraordinary wages, it is hard to see how he gets any advantage from the protection.

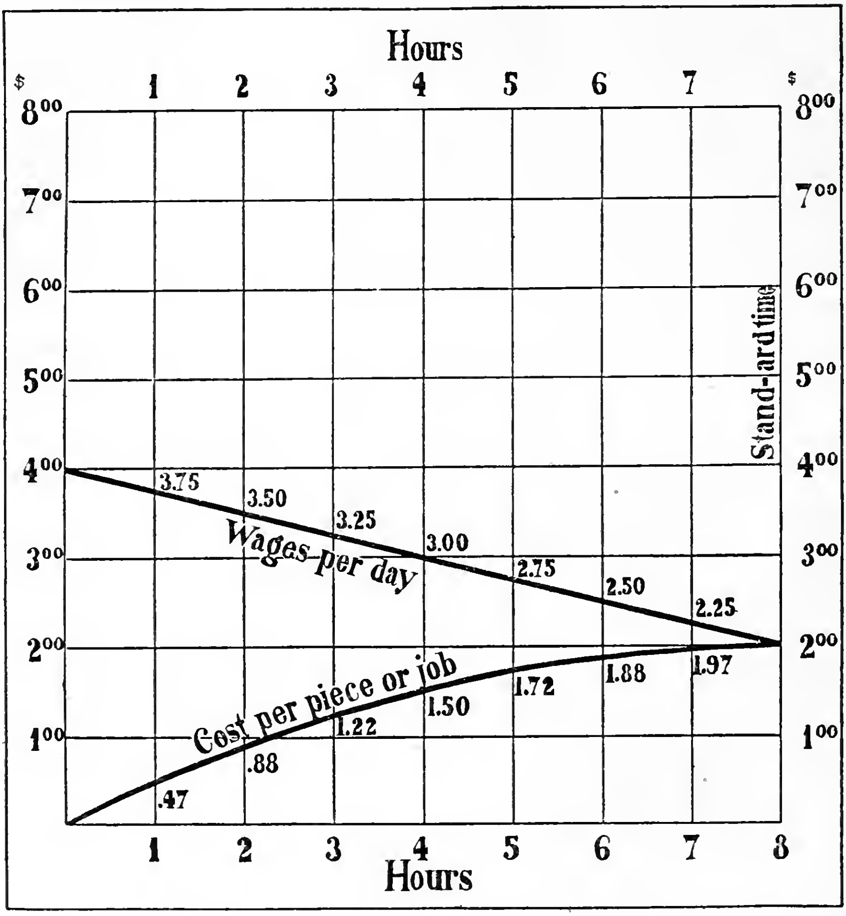

Fig. 38. WAGES AND COSTS UNDER THE ROWAN SYSTEM

Wages per day.
Direct-labor costs per piece or job.
Standard time 8 hours.
Per cent of time saved equals per cent of the bonus.

Since the Rowan plan is so similar to the Halsey system, it will not be necessary to list separately the advantages and disadvantages of it. The plan has not yet been installed in any American establishment.

Premium systems with task times scientifically set. — In passing to the consideration of the systems of Taylor, Gantt, and Emerson, it is important to observe that we leave behind those wage plans which are contented with ordinary management, and average employees, and with the attitude of putting the question of improvement of methods up to the workmen. "The great defect common to all the ordinary systems of management," said Taylor, "is that their starting-point, their very foundation, rests upon ignorance and deceit, and that throughout their whole course, in the one element which is most vital, both to employer and workman, namely, the speed at which work is done, they are allowed to drift instead of being intelligently directed and controlled." [1] From such plans we pass now to a group of systems which aim to vigorously control all conditions, to set the task with scientific accuracy, to make the task difficult enough to be worthy of a first-class man, and to offer a generous reward for successful performance, withholding from the laborer no portion of the advantage he earns by reducing his time.

The Taylor differential piece-rate system. — The author of this system was Frederick W. Taylor, the principal originator and the leading exponent of scientific management. The plan was first applied practically in the works of the Midvale Steel Company at Philadelphia in 1884. The basic principles of the system are thus set forth by their author:

(*a*) A large and clearly defined daily task for each man.
(*b*) Standardized conditions and appliances to make performance, in the time allotted, regularly possible for a first-class man.
(*c*) High pay for success.
(*d*) Loss in wages, and eventual discharge, for failure.

The preliminary requirements for the successful introduction of the differential piece rate are strictly standardized shop

[1] F. W. Taylor, Shop Management, N. Y., 1911, p. 45.

conditions, and a reënforced shop administration able to give the workmen personal explanations and demonstrations, complete written instructions, and unusually perfect service aids of all sorts.

The standard time of each job is set with great care, on the basis of motion and time studies. The time allowance is adjusted to make the task a difficult one, expressing about all that a first-class man, who is well instructed in his work, should be asked to do regularly. The task standard will depend upon the state of the labor market and the possibility of securing the quality of men desired. The aim is to be liberal with the premium rather than with the time base. Taylor sets out to pay exceptional men roundly for exceptional work; whereas Halsey and Rowan aim to coax ordinary men along a moderate course of improvement.

Since so much care is used in setting the time base, and so much administrative effort is devoted to keeping all the conditions such that there will be no cause outside of the workman's own volition why he should not accomplish his task, it is logical that the rate of pay should be so adjusted as to strongly stimulate the workman to do his part. This stimulus is produced by using two piece rates. For those who fall below the standard in quantity or quality of work, a piece rate is fixed which is so low that the workman will earn less than day wages and so, after attempting to reach the standard but failing, will quit and go elsewhere. For those who succeed, a very high rate of pay — from 30 to 100 per cent higher than the average of the trade[1] — is fixed. This attracts the superior men, stimulates them to do their best, and pays them more than they can earn elsewhere.

[1] "The exact percentage by which the wages must be increased in order to make first-class men work to their maximum is not a subject to be theorized over, settled by boards of directors sitting in solemn conclave, nor voted upon by trades unions. It is a fact inherent in human nature and has only been determined through the slow and difficult process of trial and error." — F. W. Taylor, Shop Management, N. Y., 1911, p. 25.

The plan differs from straight piece work by using two rates, a lower one for unsatisfactory work, a higher one for satisfactory work. Like piece work, however, it gives the work-

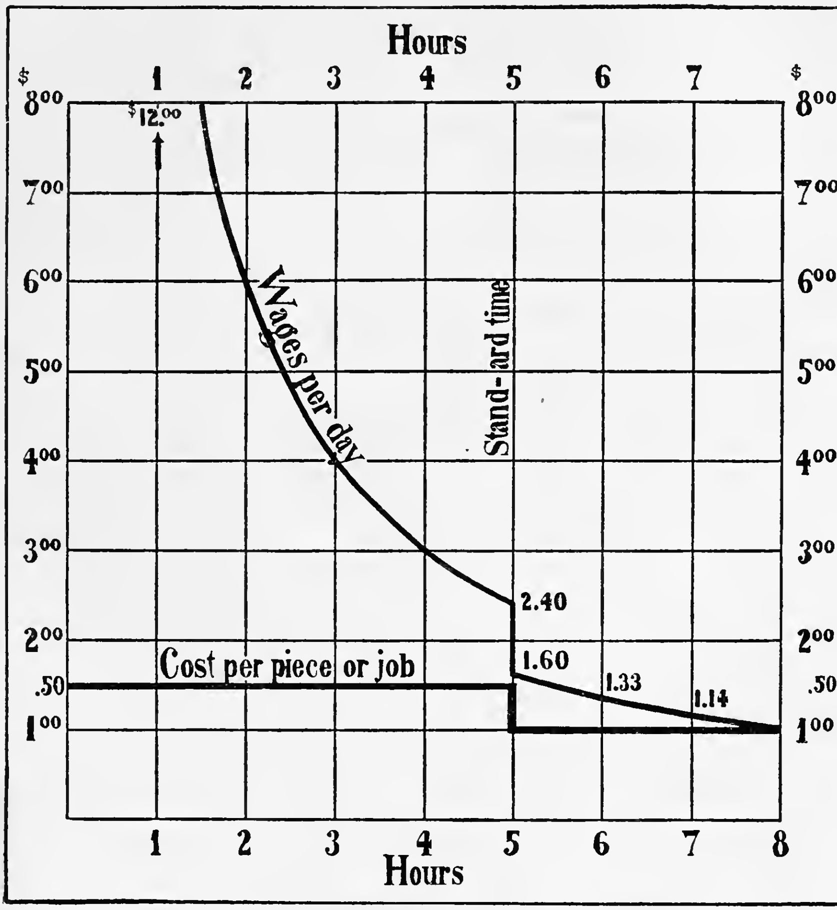

Fig. 39. Taylor Differential Piece-Rate System

Wages per day.
Direct-labor cost per piece or job
Standard time 5 hours.
Piece rates $1.00 and $1.50.

man all the wages of the time he is able to save. Mr. Taylor scorned the idea of taking from the worker any part of his wages of saved time. The employer should be content with the low overhead charge of the fast pace.

The rate having once been set should never be cut. The time base is to be revised whenever the conditions of production furnished by the management are altered in such a way that the task set is virtually a different one. It will be observed from the chart that the workman who just fails to reach the standard receives $1.60 per day, while the pay for attaining the standard is $2.40. At the division line between satisfactory and unsatisfactory performance the contrast in remuneration is marked. There is thus set up a vigorous culling action, which attracts the attention of the management strongly to those employees who are not earning the bonus. Of this feature Mr. Taylor said, "It automatically selects and attracts the best men for each class of work, and it develops many first-class men who would otherwise remain slow and inaccurate, while at the same time it discourages and sifts out men who are incurably lazy or inferior." [1]

Rewards are to be calculated on the basis of a period of time, say a day or a week, so that sustained performance is required. Failure on one job will offset success attained on another.

Advantages. — I. There is in this system the stimulus of high standards. Of the management there is demanded complete mastery of conditions, and the ability to set a definite task; of the workman there is required a performance which demonstrates him to be a first-class man of his trade.

II. The functions of management and of performance are clearly distinguished. The management sets the conditions, and in that setting determines its profits; the men put forth their efforts as operatives, receiving all the wages of gained time.

Disadvantages. — I. The culling action at the point of achieving the task is so severe that the definition and measurement of the task, and the control of each of the conditions set

[1] F. W. Taylor, A Piece-Rate System, Proc. Am. Soc. of Mech. Eng., Vol. 16 (1895), No. 647, p. 858.

for the workman, must be attended to with great care to avoid complaint and a sense of injustice. This point Mr. Taylor recognized, for he said, "When the work is of such variety that each day presents an entirely new task, the pressure of the differential rate is sometimes too severe. The chances of failing to quite reach the task are greater in this class of work than in routine work; and in many such cases it is better, owing to the increased difficulties, that the workman should feel sure at least of his regular day's rate which is secured him by Mr. Gantt's system in case he falls short of the full task." [1]

II. Because of its exacting nature the system has a limited range of applicability in industry. It can succeed only where first-class operatives work under conditions controlled by scientific management. The author of the plan very candidly recognized these requirements. He never recommended the plan as one suitable for application to all types of work throughout an establishment. To him each of the major plans of wage payment had its peculiar advantages, and its special field of application, provided always that a definite task could be assigned. "It is clear," he says, "that in carrying out the task idea, after the required knowledge has been obtained through a study of unit times, each of the four systems, (*a*) day work, (*b*) straight piece work, (*c*) task work with a bonus, and (*d*) differential piece work, has its special field of usefulness, and that in every large establishment doing a variety of work all four of these plans can and should be used at the same time." [2] In the establishments with which Mr. Taylor was connected three or four wage systems were maintained side by side.

It is to be noted, however, that the basic plan of a differential piece rate possesses great inherent flexibility. The larger the number of determinative elements there are entering into the fixing of a wage, the more flexibility a plan possesses, since each element may be taken at a higher or lower point, or

[1] Shop Management, N. Y., 1911, pp. 78–79. [2] *Ibid.*, p. 80.

may be given a greater or less degree of weight and inclusiveness. In the day-rate plan, for example, we can distinguish a certain rate of pay offered for time, a certain range of talent or performance included within the wage class, and a certain liberality or the reverse in making promotions into and out of the class. There are also the efforts of the administration to improve the working conditions, and the pressure exerted upon the men by foremanizing methods. The Taylor differential piece rate possesses all but the first of these elements, and in the place of this single rate based upon time, it has two rates based upon output. The basic plan of a differential piece rate permits of the use of three or four rates, or even more. And it permits of a greater or less spread between them, so as to increase or decrease at will the culling action at each transitional point.

The Gantt system. — The system sometimes described as "task work with a bonus" was devised by Mr. H. L. Gantt, while associated with Mr. F. W. Taylor at the works of the Bethlehem Steel Company. It is based on the Taylor differential piece-rate system and is, as Mr. Gantt says, "As far as possible removed from the old-fashioned method of fixing piece rates from records of the total time it has taken to do a job." [1]

Upon the basis of strictly standardized shop conditions Mr. Gantt sets a definite daily task which represents a first-class performance. "If a man follows his instructions, and accomplishes all the work laid out for him, as constituting his proper task for the day, he is paid a definite bonus in addition to the day rate which he always gets. If, however, at the end of the day, he has failed to accomplish all of the work laid out, he does not get his bonus, but simply his day rate." [2] The pay of those who attain or excel the standard consists, then, of the day rate for the time allowed as standard for the task accomplished, plus an agreed percentage — anywhere from

[1] A Bonus System for Rewarding Labor, Trans. Am. Soc. of Mech. Eng., Vol. 23 (1901), p. 373. [2] *Ibid.*, p. 342.

20 to 50 per cent — of that time calculated at the day rate, added as a bonus. Let us assume a case where the day rate is 25 cents per hour, and the bonus is 20 per cent of the standard time. If a workman completed a 5 hour job in 6 hours, he would receive the day rate for 6 hours, or $1.50 for the job, which is at the rate of $2.00 per day. If he did the work in 5 hours he would receive the day rate for 5 hours, plus 20 per cent of 5 hours, or a total wage of 6 hours, or $1.50 for the job, which is at the rate of $2.40 for the day. If he did the work in 4 hours he would still receive the day rate for 5 hours, plus 20 per cent of 5 hours, or the hourly rate for 6 hours, making $1.50 for the job, or at the rate of $3.00 per day. The system is obviously a day wage for sub-standard workers, and a piece rate for men who are standard or better. The difference between the Taylor and Gantt systems is that for sub-standard workers the Gantt system guarantees day wages, while the Taylor system does not; and that for workers who are standard or better the Taylor system pays by the piece, while the Gantt system pays in terms of time calculated at day-wage rates.

Mr. Gantt considers the guarantee of the day wage essential, because it reassures a labor force and facilitates the transfer of a shop onto scientifically set piece rates. He says, "When it is realized that proper piece work will, in many cases, produce at least three or four times as large an output as ordinary day work, the difficulties of putting directly on piece work men who have been accustomed to doing work in their own way and in their own time would seem to be, and generally is, extremely difficult. While the men who are on day work usually realize that they are not doing all they can do, when they are told that it is possible to do three or four times as much as they are doing they simply do not believe it, and it is very difficult to make them accept, as just, a piece rate founded on this basis; but a reward in addition to their day rate constantly held before them will finally be striven for by some one, and when one has obtained it others will try for it. In

other words, if the instruction card is made out, and a substantial bonus offered, time will do the rest."[1]

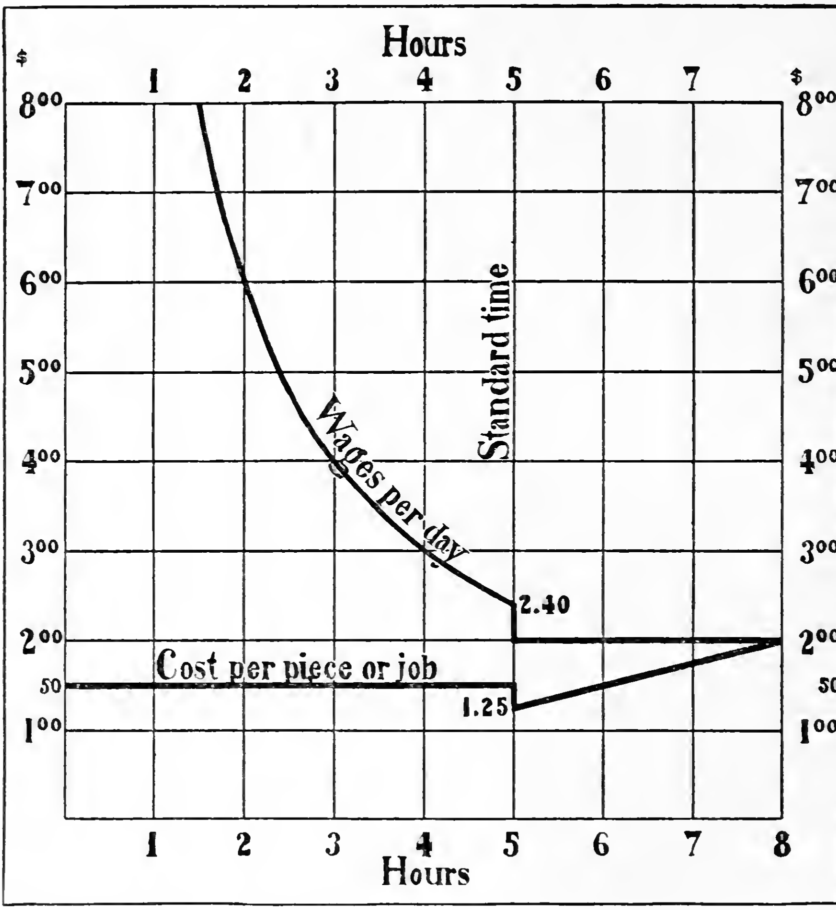

Fig. 40. WAGES AND COSTS UNDER THE GANTT BONUS PLAN

Wages per day.
Direct-labor costs per piece or job.
Standard time 5 hours.
Day rate 25 cents per hour.
Bonus 20 per cent of standard time.

As Mr. Gantt pays a liberal bonus for satisfactory performance, there is a culling action just at the point of attaining the

[1] A Bonus System for Rewarding Labor, Trans. Am. Soc. of Mech. Eng., Vol. 23 (1901), p. 343.

standard, though it is not as severe as under the Taylor system. To prevent hardship, however, Mr. Gantt provides that only those who are properly instructed, and likely to succeed, shall be allowed to try for the bonus. The workmen who remain on day wages are looked upon as overpaid during a temporary apprenticeship, pending their attainment of the standard. As the guarantee of day wages weakens the culling action and reduces the strength of the motive for attaining the standard, Mr. Gantt employs various agencies to bring a shop up to the standard. To arouse the foremen to assist heartily, a bonus is paid them proportional to the number of their men who attain standard; and there is besides an extra remuneration when a shop is composed entirely of bonus workmen. It is to be noticed that this bonus is upon the proportion of the men who succeed in attaining standard, and not upon the earnings of the men. The foremen are encouraged to aid the men to get into the bonus class, but not to drive them beyond what the management has set as a fair day's work. A bonus society is sometimes organized among standard workers, to confirm them in well doing by means of social distinction. For those whose efforts demonstrate their unfitness, transfers to other kinds of work are arranged.

The Emerson efficiency wage. — The system devised by Mr. Harrington Emerson is like the Taylor and Gantt systems in that shop conditions are thoroughly standardized, that the tasks are carefully set by time studies, and that these tasks constitute, when performed in standard time, about all that a first-class man should do. It further resembles them in that the worker is paid for all the time he saves above the standard, and that the assistance of counselors and production experts is provided for the workers. It agrees with the Gantt system in guaranteeing day wages as long as a man is retained, regardless of performance. The distinctive feature of the plan is the gradual nature of the transition effected from the day rate to the piece rate as performance improves.

Remuneration is on the basis of efficiency. A workman's efficiency is the ratio between the time set and the time he has taken; that is to say, between the standard hours of his finished jobs and the clock hours he has consumed. If in a month a man finishes jobs having a total standard time of 180 hours, and has worked 240 hours, his efficiency is $\frac{180}{240}$, or $\frac{3}{4}$, or 75 per cent. If he has in 240 hours finished jobs the standard times

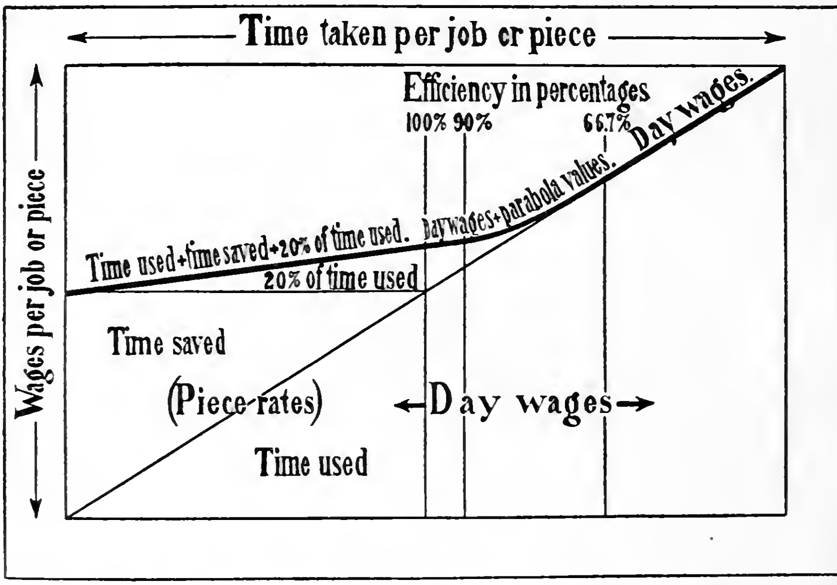

Fig. 41. Composition of the Emerson Efficiency Wage Plan

of which total 300 hours, his efficiency is $\frac{300}{240}$, or $\frac{5}{4}$, or 125 per cent.

The accomplishment of the task in standard time is 100 per cent efficiency. For men who are 100 per cent efficient, the wage is the rate for the allowed time (which in this case is the same as the time used) plus 20 per cent of the time used. The bonus begins at 66.7 per cent efficiency. For slower performance than this day wages only are paid. A man who cannot attain 80 per cent efficiency is deemed to be engaged on the wrong kind of work, and is changed as soon as opportunity permits. Between 66.7 per cent and 100 per cent effi-

ciency the worker receives, in addition to his day wages, a percentage bonus calculated on the wages of the time used, which increases gradually to 20 per cent as an efficiency of 100 per cent is approached. These bonuses of the approach to the standard are calculated from the positions of a certain parabolic curve connecting the day-wage line at 66.7 per cent efficiency with the point of 120 per cent of day wages which is the remuneration for 100 per cent efficiency.

To better reveal the construction of the Emerson wage we insert a special chart showing the change which takes place in remuneration as a given job is done in different times.

The simplified bonus table which is used in practice, for calculating the parabola values, groups the efficiency percentages upon whole numbers of bonus percentage.

Simplified Bonus Table

Percentage of Efficiency	Percentage of Bonus	Percentage of Efficiency	Percentage of Bonus
67.00 to 71.09	0.25	89.40 to 90.49	10.
71.10 " 73.09	0.5	90.50 " 91.49	11.
73.10 " 75.69	1.	91.50 " 92.49	12.
75.70 " 78.29	2.	92.50 " 93.49	13.
78.30 " 80.39	3.	93.50 " 94.49	14.
80.40 " 82.29	4.	94.50 " 95.49	15.
82.30 " 83.89	5.	95.50 " 96.49	16.
83.90 " 85.39	6.	96.50 " 97.49	17.
85.40 " 86.79	7.	97.50 " 98.49	18.
86.80 " 88.09	8.	98.50 " 99.49	19.
88.10 " 89.39	9.	99.50 and over	20.

It will be noticed that above 90 per cent efficiency the bonus increases one per cent for each increase of one per cent in efficiency, until 100 per cent is reached. For all efficiencies above 100 per cent the workman receives the wages of the time

worked and of the time saved — that is to say piece rates — plus 20 per cent of the wages of the time worked.

To summarize:

Efficiencies 66.7 per cent and less receive time worked.
Efficiencies 67 per cent to 100 per cent receive the time worked plus parabola bonuses.
Efficiencies 100 per cent and over receive time worked plus time saved plus 20 per cent of time worked.

Advantages. — I. The gradual increase of the bonus above day wages from 66.7 per cent to 100 per cent efficiency, and the gradual decrease of the bonus beyond 100 per cent down to piece rates, makes an easy transition from the day rate to the piece rate. The learner is encouraged to strive and to learn by gradually increasing rates of remuneration. In comparison with the Taylor and Gantt systems, the philosophy of this system is less that of culling for native capacity, and more that of bringing men up to the standard by persistent effort, patient instruction, and growing reward. Those who fail to reach the standard are not discouraged by being thrown back upon the flat day rate. "It is discouraging to workmen," says Mr. Emerson, "to expert, and to employer to be wrecked in full flight by hard iron from the foundry, by variable speed in the engine, by broken belt on main shaft, by any unforeseen and unforeseeable delay, and in such cases the curve back to day rate prevents much trouble." [1]

II. Since there is not at any point a great drop in remuneration, by reason of barely failing to attain some specific standard of performance, the question of the exact degree of liberality employed in setting the time base, and the matter of the accuracy used in measuring those jobs which are on the edge of the standard, is not of so great importance as in shops with the Taylor or Gantt systems.

[1] Trans. of Am. Soc. of Mech. Eng., Vol. 25 (1903), p. 81.

III. The percentage of efficiency is not calculated in practice for each job, but for a period of from two weeks to a month. While day wages are paid weekly, the bonus may be calculated

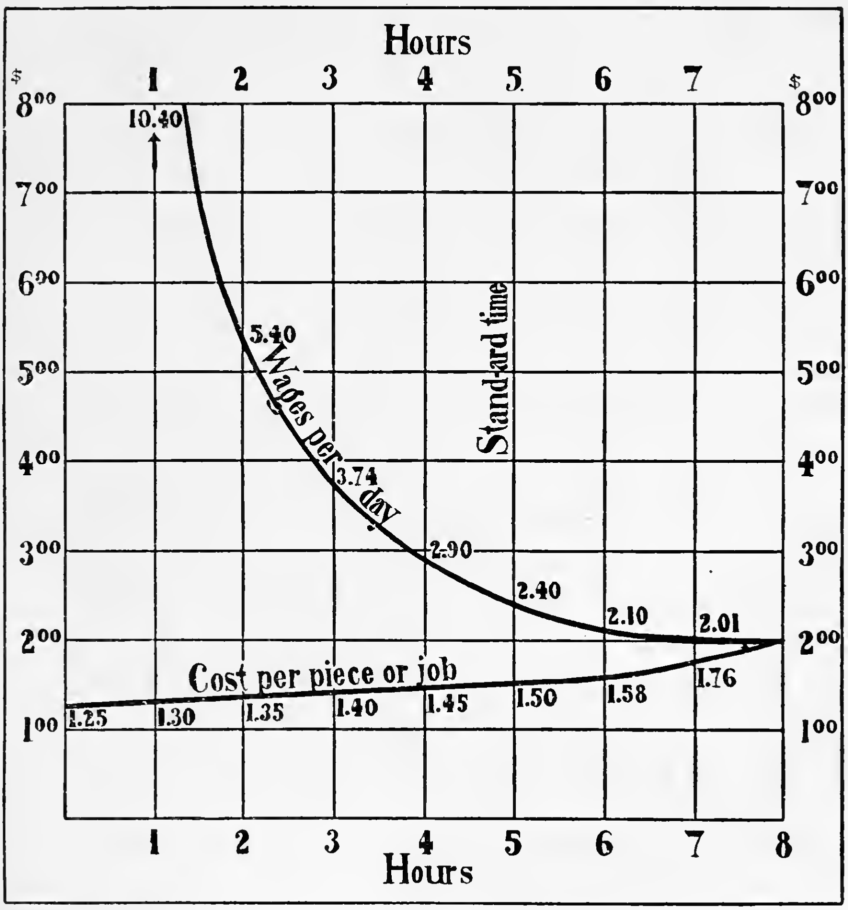

Fig. 42. Wages and Costs under the Emerson Efficiency Plan

Wages per day.
Direct-labor cost per day or job.
Standard time 5 hours.
Day rate 25 cents per hour.

and distributed every other week or every month. This saves pay-roll expense. It also prevents the workman from beating the system by resting upon day wages after a raid on the

premium. It causes a shop to be somewhat less on edge with reference to the attainment of the exact standard on each job. Accurate labor costs are, of course, distributed to each job by the cost keepers.

The law of labor response to variation of wage. — The systems to which consideration has been given are attempts to pass from ordinary wage levels to higher levels which will balance the labor market for extra-normal performance. It may very well be that experiments will eventually show that definite relations tend to exist, for any given time and place, between the price of an ordinary day's work and the price of various degrees of extra service. Mr. Taylor has said, "The writer has found, after making many mistakes above and below the proper mark, that to get the maximum output for ordinary shop work requiring neither especial brains, very close application, skill, nor extra hard work, such, for instance, as the more ordinary kinds of routine machine shop work, it is necessary to pay about 30 per cent more than the average. For ordinary day labor requiring little brains or special skill, but calling for strength, severe bodily exertion, and fatigue, it is necessary to pay from 50 per cent to 60 per cent above the average. For work requiring special skill or brains, coupled with close application, but without severe bodily exertion, such as the more difficult and delicate machinist's work, from 70 per cent to 80 per cent beyond the average. And for work requiring skill, brains, close application, strength, and severe bodily exertion, such, for instance, as that involved in operating a well-run steam hammer doing miscellaneous work, from 80 per cent to 100 per cent beyond the average." [1]

On the same point Mr. Emerson gives us somewhat different details. "We find," he says, "we can double a 40 per cent efficiency by paying a bonus of 3.25 per cent, that we can double a 45 per cent efficiency by paying a bonus of 10 per cent, that we can double a 50 per cent efficiency by paying a bonus of

[1] Shop Management, N. Y., 1911, p. 26.

20 per cent, and that we can double a 60 per cent efficiency by paying a bonus of 40 per cent." [1]

The question of distributive justice. — The various wage systems which have been reviewed reveal two chief purposes: (*a*) to offer an increase of wages to the employee in exchange for a better performance and (*b*) to reduce costs to the employer as the reward for better management. Since an increase in efficiency produces an extra sum of profit, it is easy to get the idea that the problem of devising a satisfactory wage plan is the problem of making some equitable division of this profit. Mr. J. M. Dodge has said — and claimed the endorsement of Mr. F. W. Taylor in saying it [2] — that the aim of the leaders of scientific management has been so to divide between wages and profits any gain which may be made in earnings that the previously existing proportions between these two shares shall remain undisturbed. If we are entitled to interpret this statement strictly, the meaning of it is that, if wages have been $100,000 and profits $20,000, and if net earnings are increased by $50,000, the added sum should be divided $41,667 to wages and $8,333 to profits; that is to say, each should be increased by $41\frac{2}{3}$ per cent. This may appear to be a neutral position with reference to the conflicting claims of labor and capital, but in reality it is not so, unless the fair market values of the sacrifices made by the men and the management in attaining the increased profit happen to fall into the proportion which previously existed between wages and profits. It should be understood that the bonus and premium and differential piece-rate plans of paying wages are not attempts to put upon the worker any portion of the hazard of the uncertain relation between costs and prices, and so inaugurate a new form of profit sharing. They are simply efforts to find a workable relation

[1] Harrington Emerson, A Comparative Study of Wage and Bonus Systems, N. Y., The Emerson Co., 1912, p. 36. See further, H. L. Gantt, Work, Wages, and Profits, N. Y., 1910, pp. 39–40.

[2] Compare page 274, note.

between the current wages which pay for ordinary efforts, and the extra remuneration which will adequately pay for extra labor service.

The true problem of wages under scientific management, or under any other type of management, is not to divide a profit, but to find the levels of remuneration which will ensure the necessary coöperation of operatives and staff workers, while yet offering to capital sufficient interest and profits to ensure its coöperation. If there is any surplus beyond these requirements it will be left with the entrepreneur or final risk-taker, pending such an increase of competition between entrepreneurs as will hand it over to the public, in the form of lower prices. There is no logical process, nor abstract principle, nor fixed relation of wages to profits, available for determining what fair wages or workable wage levels are. Experiment with supply and demand is the sole original source of information in an industrial society organized under the system of free competition. Enough must be paid the laborers to ensure the necessary response in numbers, in native talent, in energy, and in hearty coöperation. All that administrative effort can do is to make more definite the terms of the wage problem by dispensing with all ambiguities as to the conditions, as to the talent required, and as to the nature of the task; and thus by disposing of all collateral issues, facilitate the focusing of supply and demand upon the crux of the question, namely, the relative value of a unit of muscular and nervous energy expended in labor, in comparison with a unit of managerial brain power, and a unit of self-denial and nervous tension involved in saving and risking capital.

The wages of contentment. — The basic conception of a scientific wage is fairness. The concept of what is fair blossoms out of that which is usual, current, and customary. It is a growth fed by innumerable experiences in social adjustment too complex for logical analysis to follow, and being constantly corrected by allowances for the new productive power acquired

by industry. The idea of a fair wage is not a sharp definition but a general impression. The general range is sensed; the exact point is never discovered. It is the recognition of a tendency to which individual cases conform but approximately.

The practical test of fairness is contentment; contentment of wage earners, of capitalists, of managers, and of the general public. The value of contentment as a test of equilibrium has been emphasized again and again by the advocates of scientific management as they have pointed out how indispensable is the hearty coöperation of the employee. The very delicacy of the instrumentalities and the exactness of the coördination involved in attaining new levels of efficiency in industry constitute increasing hostages to the laborer, ensuring to him fair treatment. To pay less than is felt to be fair means that, while the muscle may function, the mind will be alienated, and the spirit will fail. To pay more means to make a gift, a thing which may be desirable enough in itself, but which cannot be looked upon as a permanent feature of any administrative system subject to competition, except in so far as gifts take the form of welfare features and idealistic experiments which elevate the conception of what is decent and proper in industry, and so finally raise the entire plane of competition. Apart from this reaction of those exceptional cases which mark the frontier of upward striving, upon the general custom, competition between producers will at last give whatever residual advantage may remain, after the factors of production have asserted themselves normally, to the consuming public in the form of lower prices. The consuming public is, however, chiefly composed of the laboring classes.

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CHAPTER XV

WELFARE WORK

Welfare work and betterment work are two titles used to designate the voluntary efforts of employers to improve the condition of their employees. It has to do with benefits which are over and above what the law requires or the necessities of competition exact.

Origins. — In so far as welfare work can be traced to a definite origin, it may be said to have had its rise in the ingenious and successful efforts made by Robert Owen, in the first quarter of the nineteenth century, to improve the conditions of his employees in the cotton mills of New Lanark, Scotland. By way of doing honor to the extraordinary energy of this pioneer in the evolution of the modern type of industrial management let us quote a couple of paragraphs indicating his philosophy and his achievements.

"He tells, in his autobiography, with what enormous difficulties he had to cope when he purchased the property. Women and children were employed under conditions which debased both mind and morals; drunkenness and ignorance, filth and immorality, were the characteristics of the population. Owen believed, however, in the omnipotent effect of circumstance in molding character. He, therefore, set himself to work out reform on this principle.

"Drunkenness was discountenanced by the introduction of resorts where the workmen could find both pleasure and profit; immorality was checked by informal lectures setting forth its practical evils; the employment of young children was

discontinued; the homes of the people were materially improved; good, honest provisions were supplied at cost price; children's schools were started; and insurance funds against old age and illness were not forgotten." [1]

The influence of the modern executive. — More broadly considered, the movement among employers to improve the conditions of their workmen, by their own efforts, and without calling upon the state for interfering legislation, owes its beginning to no one man. It is the revolt of men of affairs, with somewhat better education in physiology and psychology than their predecessors, against the narrow utilitarianism which characterized the early development of the factory system. It marks the passing of establishments from the control of the harsh men of combative type who fought their way up from the ranks into administrative circles too late to learn the art, into the hands of men trained for administration, capable of broad views, and understanding their responsibilities. It is the natural endeavor of executives, who know something of sociology, and desire to be something besides money makers, to assist those within reach of their influence to attain good health and efficiency, and to enjoy beautiful things and experience human fellowship. The movement is eminently practical in its origin: it is a business man's affair, owing little to professional reformers, being entirely distinct from charity and penology, and allowing small influence to broad theories and sentimentality.

On its lowest plane, welfare work is the act of conforming to the laws of productive efficiency in some uncommon way, which not only pays the employer in profits, but which makes work and the working environment seem more attractive to the wage earner. In this sense, it may be conforming to some rule of health, or observing some law of attention and interest or of fatigue, or drawing upon some subtle spring of loyalty and enthusiasm.

Just now, in America, one object of the movement is to

[1] The Encyclopedia of Social Reform, N. Y., 1908, p. 859.

undo the work which "big business" has done in separating men from each other in work and rank and interests and standards of life, and to do so by reasonably systematic and persistent efforts to get together.

A phase of general progress. — As the per capita production of wealth of the country increases, the conditions of life of the people can be improved. We can enjoy better homes and schools, better food and clothing, better reading and recreation, because there are more of the good things of life available. It is reasonable that, as other classes elaborate the arts of living, the working classes should rise in the scale of comfort as well. And since these classes spend so large a part of their waking hours in work places, it is natural that this advancement should show not only in the family life, but in a progressive improvement of the conditions of the working day.

The general movement is at first a thing of sporadic signs — an experiment in one plant, a new feature in another — but becoming more frequent and more consistent in type. In their initial stage these improvements in comfort seem to be non-economic, or at least extra-competitive, in character. They are viewed with suspicion as philanthropies, although strenuously defended as "good business" by their sponsors. It is not observed that they are the advance heralds of a new equilibrium between production and consumption. It is only when the experiments multiply, and persist along certain lines, and the new comforts become generally disseminated, and are more and more forced upon backward employers as a part of the plane of competition — that is to say, as something expected as customary or standard — that we are able to recognize them as legitimate signs of the nation's increasing wealth and comfort.

The geography of the movement. — The chief development of welfare work has been in France, Belgium, Holland, Switzerland, and the United States. The movement is not prominent

in England, although there are in that country such splendid examples of it as Lever Brothers Ltd. of Port Sunlight, and Cadbury Brothers Ltd. of Bourneville; and although there is also in England the "garden city movement," which is strongly influencing popular conceptions of comfort. The reason for this lack in England is that the extreme conservatism of the English employing classes has forced the amelioration of the conditions of the wage earners to come chiefly as the result of industrial warfare, carried on by the trades unions. Nor has welfare work been extensively carried on in Germany, in spite of such exceptions as the Krupps. And this is to be accounted for by the all-embracing influence of state-socialism, which causes reforms to come chiefly through the force of law and by the action of governmental agencies. In America, the land of private enterprise, welfare work has found its most congenial home. Here there are ample resources, a favoring theory of democratic equality, a strenuous habit of putting projects through to the limit, a daring idealism among business men, and a well educated public opinion. Welfare work may be looked upon as the typical American way of making socio-economic adjustments between the industrial classes, and of discouraging the importation of European trade warfare and European state-initiative.

What it comprises. — With reference to the physical conditions of the wage earners, welfare work includes such things as good air and light, lockers for clothing, dressing rooms, baths, the provision of wholesome food for the midday meal, rest rooms for women, medical examinations, first aid to the injured, free hospital beds, visiting nurses, opportunities for organized athletics, and vacations with pay. Under the head of economic agencies it includes such things as shop schools, technical lectures, and the circulation of technical literature; prizes and bonuses for suggestions, and for length and regularity of service; sickness, accident, and old-age pensions; improved housing facilities, and agencies for the promotion of thrift.

Upon general moral and social conditions it exerts an influence, not only through the above-mentioned channels, but by means of amusement facilities, such as concerts and entertainments; by clubs and societies; through the influence of a social secretary; through the precautionary exclusion of undesirable persons; and through the agency of artistic surroundings, not only within doors, but as the result of the landscaping of the factory grounds.

With so wide a range of optional directions in which effort can express itself, welfare work may be adapted to local conditions, to any scale of expenditure, and to the peculiar talents and interests of employers and employed. This variety, however, has interfered with the recognition of underlying principles, and has made difficult the communication of the wisdom of experience from one establishment to another. As a result of this, the period of experimentation of the movement as a whole has been unduly prolonged.

Let us choose for brief consideration, the following items: 1, factory hygiene; 2, housing; 3, education; 4, club activities; 5, the beautification of the industrial environment.

Factory hygiene and preventive medicine. — The recent popularity of the ideal of *Mens sana in corpore sano* may, perhaps, be partly due to the vogue of college athletics. It is certainly due in part to the increased activity of the medical profession in spreading knowledge concerning public health. By reason of the evolution of the building trades, and the invention of improved systems of heating, lighting, and ventilation, it has become possible to do what was once impossible, in the matter of providing for the physical comfort of employees. Better quarters are now within reach without increase in cubic-foot cost. And since man-hour rates have increased, the law of profit has become more nearly the law of health.

Dressing rooms. — Toilet rooms, dressing rooms, and lockers enable a force to keep clean and to wear dry clothes. A fundamental manifestation of self-respect is cleanliness of body and

neatness of dress. Self-respect is a valuable characteristic in an employee, for it sets a limit of decency and fairness below which his actions will not be allowed to go, because they would not be worthy of himself. It is no longer customary for shop employees, above the grade of unskilled labor, to go and come on the street in work clothes; dressing rooms, lockers, and drying racks have, therefore, become indispensable, if a superior personnel is to be secured. This is not simply a manifestation of pride; it is an intelligent differentiation between the cut and materials of working clothes and street clothes.

Rest rooms. — A rest room or parlor for women, and a reading room or game room for men, are useful installations to permit the employees to pass the rest portion of the noon hour under cover in bad weather, but outside of the work rooms while those are being ventilated. Such facilities give a touch of home to a plant. They are especially valuable for women, who lack the endurance and regularity of health of men, and who are more subject than men to dizziness, fainting spells, and temporary collapse from fatigue. If women have less dependable health than men, they recover more readily from slight illnesses than do men, if prompt attention is given to their condition.

Baths. — The installation of shower baths is becoming the accepted thing in establishments where the occupation is uncleanly, as in cotton and woolen manufacture, the sorting of rags for paper stock, stone cutting, the grinding and polishing of metals, the handling of wool or hair, and hide cleaning. It is even more important in chemical works where poisonous dust and fumes are generated, or in any manufacture where lead enters as a component, as in the making of paint, pottery, and plumbing supplies, or the manufacture of cut glass.

The Walker and Pratt Company of Boston provides a daily shower bath for foundrymen, and the Lowe Brothers Company of Dayton does the same for color workers. The Sherwin-Williams Paint Company of Cleveland requires a daily shower

bath for the men in the dry-color department, and provides daily a clean suit of underwear which the men wear during the day, changing into their own clothes before leaving the establishment. Previous to the adoption of this rule, 20 per cent of this force was ill, and the average service in the department was but one and one-half months. Since the new arrangements have been in force, illness from lead poisoning and kindred diseases has become practically negligible, although the personnel of the department is now permanent.

A portion of the rules posted in the works of The National Lead Company is as follows:

1. RESPIRATORS must always be worn where there is dust. KEEP THEM CLEAN. Shave frequently so that respirator fits snugly.

2. WASHING. Before eating and before leaving factory at night, employees must thoroughly scrub their hands, clean their finger nails, and brush their teeth.

3. CLOTHES. Employees must make a complete change of clothing, including hat and shoes, upon coming to work and again at the close of the day's work. WORKING-CLOTHES MUST NOT BE WORN OUTSIDE THE FACTORY GROUNDS.

4. BATHS shall be taken daily (on Company's time) before changing into street-clothes.

5. COMPLAINTS. The company furnishes, free of charge, respirators, sponges, tooth and nail brushes, soap, towels, and individual lockers, and has equipped the Plant with bathing facilities and sanitary devices. Any failure to furnish above supplies and any defect in the operation or sanitary condition of the machinery or equipment of the factory observed by any employee shall be called at once to the attention of the foreman in charge, and if not remedied in 24 hours, COMPLAINT SHALL BE MADE DIRECTLY TO THE SUPERINTENDENT.

6. COMPANY'S DOCTOR. Employees shall report to the Company's Doctor every ailment, no matter how slight, as soon as discovered, and shall be present at the weekly examination. The Company's Doctor will attend to employees for all ailments without charge."

Physical examinations. — The health problem is being attacked not only by means of plant hygiene and sanitary appliances, but by precautionary examinations, visiting nurses, and hospital facilities. The practice of making a thorough

physical examination of applicants by a physician is growing rapidly, as a result of the enactment of state employer's liability laws; the object being to avoid the risk which would be incurred by employing those who are physically unfit for their work. The results to be expected from such examinations may be illustrated by some records of Sears, Roebuck and Company of Chicago.[1] Out of 666 applicants in a certain period, 85 were rejected for the following reasons:

Anemia and chlorosis	12	Venereal disease	7
Active tuberculosis	11	Hernia	4
Suspicion of tuberculosis	10	Tubercular glands of neck	2
Physical defects	10	Epilepsy	2
Bright's disease	9	Diphtheria	1
Sick, no definite diagnosis	9	Cirrhosis of liver	1
Heart trouble	7	Total	85

It is not to be understood that Sears, Roebuck and Company reject every applicant found to be physically imperfect. The policy is explained by Dr. Mock as follows: "We reject only those people who have some diseased condition which might be spread to the other employees if they were allowed to work among them, or those whose diseased condition is so serious that it would be very dangerous to themselves if they were allowed to work. Those with ailments which would not be detrimental to their fellow employees, and which would not be made worse by work are given positions. Suitable work is chosen for them to comply with their physical condition."

The manner in which physical examinations serve to safeguard the health of undiseased employees may be illustrated by the experience of the same company with tuberculosis. In 1909, with one doctor employed, 800 examinations were made. No tuberculosis was discovered among applicants for work,

[1] H. E. Mock, An Efficient System of Medical Examination of Employees, Trans. of 10th Annual Meeting of Nat'l Asso. for the Study and Prevention of Tuberculosis, N. Y., 1915.

for applicants were not examined. Of the 45 cases which developed that year in the force, only 11 per cent were detected in first year employees. In 1914, with six doctors employed, 12,380 examinations were made of which approximately 5,600 were of applicants for work. In this year 40 cases of tuberculosis were found among the applicants, and 115 cases developed among a very greatly increased number of employees. Of these 115 cases, 29.6 per cent were detected in those who had worked less than twelve months; an accomplishment due to the system of putting applicants with suspicious findings upon a "watch" list. This company keeps a constant lookout for those who are falling below par physically, and extends aid to them in a variety of ways.

The visiting nurse. — The employment of a visiting nurse is the recognition of two facts: first, that the nurse, previously considered as a curative agency only, is being used as an educational and preventive agency; second, that the efficiency of an employee may be quite as much reduced by wrong conditions in the home as in the factory. "A man who sits up night after night nursing a tuberculous wife or helping to care for children with croup has an increased disposition to error of judgment; he is not a safe man to run an engine." [1]

Hospital facilities.[2] — In the dangerous trades a necessary provision is a suitable place for giving care to those who are

[1] Dr. C. A. Lauffer, Standardized First Aid, Second Annual Rep. of Nat'l Asso. of Corporation Schools, 1914, p. 621.

[2] Some establishments maintaining emergency rooms or shop hospitals are —

American Locomotive Company, Schenectady, N. Y., and elsewhere.
Brighton Mills, Passaic, N. J.
Burroughs Adding Machine Company, Detroit, Mich.
Carnegie Steel Company, Homestead, Pa.
Consolidated Gas Company of New York, New York City, N. Y.
Curtis Publishing Company, Philadelphia, Pa.
General Electric Company, Schenectady, N. Y.
National Cash Register Company, Dayton, O.

injured. The minimum accommodation is an emergency room for immediate recuperation, equipped with facilities for extending first aid. Establishments of size, in engineering lines, find it necessary to enlarge their quarters into a miniature hospital; while the largest employing concerns have found it necessary to equip institutions of standard size, when there are no public hospitals in the locality.

The Colorado Fuel and Iron Company operates at Pueblo, Colorado, the Minnequa Hospital, which Doctor Lorenz of Vienna, on his visit to this country in October 1902, pronounced the finest hospital he had seen in America. This institution accommodates 216 patients. The original cost was $350,000. Many additions have been made to it. It is located in thirteen acres of landscaped grounds. This company maintains a number of retaining stations at various points, for the temporary care of patients until they can be transferred to the hospital. The need for such equipment can be seen from the fact that for the five years, 1910–1914 inclusive, the cases treated annually have averaged 98,474.

The midday meal.[1] — The growth of cities is tending constantly to enlarge the area from which the individuals of an

National Cloak and Suit Company, New York City, N. Y.
New York Edison Company, New York City, N. Y.
Sears, Roebuck and Company, Chicago, Ill.
Travelers' Insurance Company, Hartford, Conn.
Western Electric Company, Chicago, Ill.
Westinghouse Electric and Manufacturing Company, E. Pittsburg, Pa.
Yale and Towne Manufacturing Company, Stamford, Conn.

[1] Some concerns operating a lunch room for workmen or working women are as follows —

American Locomotive Company, at Schenectady, N. Y., Richmond, Va., and Montreal, Canada.
Burroughs Adding Machine Company, Detroit, Mich.
Carnegie Steel Company, Homestead, Pa.
Curtis Publishing Company, Philadelphia, Pa.
Ferris Brothers Company, Newark, N. J.
H. J. Heinz Company, Pittsburg, Pa.

establishment are recruited and so to lengthen the average distance between home and place of work. When a large proportion of the employees of a plant are reduced to the alternative of depending upon a lunch box, or a nearby restaurant, or a saloon, or of taking two long rapid walks, home and back, or of paying out two street-car fares, the juncture is created for considering the operation of a private dining-room. The midday meal is the critical one of the day, from the point of view of efficiency, for it is received into the stomach when the body is in a state of partial exhaustion, and is promptly followed by mental and physical exertion which draws the blood away from the digestive organs. It is worth while for an employer to see that this meal is composed of digestible and appetizing food, and is served at a place which will allow as large a portion of the noon hour to be spent in rest and recreation as possible.

The price problem is somewhat difficult. Food should not be given gratis; but the prices must be kept close to cost. With a reasonable number of patrons it is not hard to serve a good meal for 15 cents. While office employees will pay this price, the patronage of the operative force, which is the

Larkin Company, Buffalo, N. Y.
Ludlow Manufacturing Associates, Ludlow, Mass.
National Cash Register Co., Dayton, O.
National Cloak and Suit Co., New York City, N. Y.
National Harvester Company, Chicago, Ill., and elsewhere.
National Lamp Works, in eighteen factories.
New York Edison Company, New York City, N. Y.
Packard Motor Car Company, Detroit, Mich.
Sherwin-Williams Paint Company, Newark, N. J.
The Shredded Wheat Company, Niagara Falls, N. Y.
L. C. Smith and Brother, Syracuse, N. Y.
Solvay Process Company, Solvay, N. Y.
Thomas G. Plant Company, Boston, Mass.
United Shoe Machinery Company, Beverly, Mass.
Western Electric Company, Chicago, Ill.
Weston Electrical Instrument Company, Newark, N. J.

important one to cater to, falls off rapidly when 10 cents is passed. Those who live at home feel that food brought in a box or pail costs them very little; while those who live in boarding houses find that they can get little or no reduction for not carrying a lunch. That an appetizing meal can be served for ten cents is proved from the experience of the Rufus F. Dawes Hotel of Chicago. This institution has the following bill of fare:

Meat hash and beans	3 cents
Coffee with milk and sugar	2 "
Roll	1 "
Macaroni and bread	3 "
Mutton stew and bread	3 "
Soup with bread	2 "
Doughnut	1 "
Baked beans and bread	3 "
Pie, all varieties	3 "

In the year 1914 the hotel served 59,219 meals at an average price of $0.06288, and an average cost for labor and materials of $0.05976. Making a reasonable allowance for depreciation of equipment, the cost per meal was approximately $.06551.

The best policy for a factory restaurant seems to be to price individual dishes separately; to establish the custom that employees may bring their lunch boxes into the room; to specialize on coffee at 1 or 2 cents per cup, and soup at 3 or 4 cents per bowl, as a supplement to the solid food of the lunch box; and to make arrangements to heat or refrigerate gratis any food brought to the plant by the employees. Where a force consists chiefly of mechanics, receiving good pay, the price difficulty is diminished.

The Continental Motor Company of Detroit, with 2,500 men, serves daily as many as their restaurant will accommodate. Of the patrons about 800 take the entire noon meal, while 400 carry their own lunch, and supplement it by a hot

beverage and, perhaps, a dish or two chosen from the bill of fare. The company furnishes the space, gas, heat, and light free, allowing a caterer a small profit, and fixing the prices charged. The prices are as follows: soup 5 cents, meats 7 cents, vegetables 3 cents, pastry and fruits 5 cents, bread and rolls with butter 3 cents, tea, coffee, and milk 3 cents. The average order costs 15 cents. The office force dines a half hour earlier than the shop force.

The Jeffrey Manufacturing Company of Columbus, Ohio, has had success with a wide range of coöperatively managed welfare undertakings. With reference to the restaurant, and certain other enterprises closely connected with it, Mr. W. A. Grieves, Supervisor of Welfare for the company, says: "Many of our men, about five years ago, believed that we ought to have a restaurant. A meeting was held and committees appointed. The result was a small inexpensive lunch counter in one of our shops. It was well patronized, and in a few months was moved to larger quarters. We have now moved three different times to larger quarters, and have a thoroughly equipped restaurant, where we serve an average of six hundred daily, and we are planning to double this capacity in the very near future.

"While we sell everything at three cents, with the exception of meat, which is four cents, we have been able to save sufficient to pay for our equipment, valued at $8,000, the money for which was advanced, without interest, by the company. The food is the very highest in quality and wholesomeness; and for fifteen to twenty cents a splendid lunch, yes, even a good-sized meal, can be secured. So popular has this restaurant become, we could have tripled the number of employees using it if they could be accommodated.

"Believing there were possibilities in coöperative buying, we started to sell such articles as sugar, coffee, flour, tobacco, etc., in a small way in our restaurant. This was about three years ago. During this period the plan has grown into a good-

sized coöperative store, in which we are doing ten to twelve thousand dollars of business each month. We handle all kinds of groceries, meats, boots, shoes, rough clothing, etc. We have handled this year, through the store, about thirty-five car loads of coal, twenty car loads of potatoes, and five car loads of apples, all at a large saving in money to employees. We have our own coal wagons, auto delivery trucks, and wagons.

"Two years ago we started our own bakery in a small way, but now have an oven capacity of three thousand loaves of bread per day, with a thorough pastry and bread mixing equipment. Everything used in our restaurant is baked in our bakery. The bread is sold at four cents for a loaf two ounces larger than the usual size. We have a lard rendering plant in which we make all our own lard. This is sold at from five to six cents less per pound than it can be secured at other stores. We have established our own dairy farm, from which we have fresh morning milk for lunch each day. We have, also, our own ice cream factory, and during the summer months sell a large-sized dish of ice cream — made of cream from the farm — for three cents.

"All this work is fostered and encouraged by the company, but the management and organization is carried on entirely by committees of shop men. The company advanced us the money to get started, but we have paid almost all of it back." [1]

The prices at the Jeffrey restaurant are: meats 4 cents, vegetables 3 cents, bread and butter 2 cents, desserts 3 cents, beverages 3 cents. The National Biscuit Company serves in its New York plant a dinner consisting of hot meat, potatoes, bread and butter and coffee or tea for eleven cents.

Housing.[2] — It seems to many persons a considerable departure from ordinary business enterprise for an employer to

[1] W. A. Grieves, The Handling of Men, Detroit, 1915, pp. 12–13.

[2] Some of the companies which provide housing accommodations are —

American Viscose Company, Marcus Hook, Pa.
Bethlehem Steel Company, Bethlehem, Pa.

invest money in housing accommodations for his employees. It is not that any one doubts the connection between the material conditions of the workman's home and his health, thrift, and morals; but that industry has so completely withdrawn from the household that we think of these two institutions as completely divorced and existing at opposite ends of the economic scale.

The advantages of operating in real estate on a large scale are, ability to plot land correctly, the saving of unearned increment on land, control of nuisances, the providing of correctly designed floor plans and adequate specifications, a much reduced cost of building, and a great increase in the convenience, beauty, and attractiveness of a locality, with little or no increase in outlay. Some of the dangers to be avoided are, a barracks-like effect, undue intermeddling with the employees' outside life, and the growth of an attitude on the part of under-officers that what is done for the employee outside may offset — and so perpetuate — administrative deficiencies inside.

Cheney Brothers, South Manchester, Conn.
Dwight Manufacturing Company, Alabama City, Ala.
H. C. Frick Coke and Coal Company, at many points in southwestern Pennsylvania.
John A. Roebling's Sons Company, Roebling, N. J.
Joseph Bancroft and Sons Company, Wilmington, Del.
Ludlow Manufacturing Associates, Ludlow, Mass.
Maryland Steel Company, Sparrows Point, Md.
Monaghan Mills, Greenville, S. C.
Nelson Valve Company, Wyndmore, Pa.
Peacedale Manufacturing Company, Peacedale, R. I.
Pennsylvania Railroad Company, Enola, Pa.
Plymouth Cordage Company, Plymouth, Mass.
S. D. Warren and Company (Cumberland Mills), Westbrook, Me.
Westinghouse Air Brake Company, Wilmerding, Pa.
Whitin Machine Works, Whitinsville, Mass.
Willimantic Linen Company, Willimantic, Conn.
Wiscasset Mill, Albemarle, Ga.

A village problem. — Housing is chiefly a village enterprise. If a manufacturing plant is built in the open country, or in a small village, local capital and enterprise may not be adequate, and outside capital may be disinclined to invest in an enterprise depending upon a single corporation. Again, a manufacturer who has developed an industry requiring skilled labor, in a village, may find that the superior workmen and the more ambitious families are being attracted away by the lure of the large city, so that it is necessary to develop a counterbalancing attraction in the village life. As the art of city planning develops, and the "garden city" movement extends itself, it is becoming evident that the village can successfully develop such attractions, and can hold people of good taste and general intelligence.

Houses to rent. — The practice of renting houses may be illustrated by the Pelzer Manufacturing Company of Pelzer, S. C., which owns all the land about the mills, and controls the unincorporated town of Pelzer. At Ludlow, Mass., the Ludlow Manufacturing Associates have built most of the houses, and constructed the streets and schools and churches. The Colorado Fuel and Iron Company, at many of its camps found only adobe huts and shacks and tents used as dwellings. It was obliged to build houses, and teach the foreign-born women and neglected children the rudiments of the domestic arts, in order to bring living conditions to a decent standard. Its rental rate is $2.00 per room per month. At Hopedale, Mass., The Draper Company employs practically all of the working population. It has built beautiful houses for its employees, and transformed the setting into a landscaped park. After the tract of land was purchased, the company had it laid out by a landscape architect. Macadam streets were then built, and all improvements put in. The plans for the houses were secured from several leading architects, to obtain variety of style, and yet allow of buildings or apartments of approximately equal size. The houses are provided with

hardwood floors, cement cellars, and modern plumbing. The company keeps the buildings in repair, and insists upon the tenants keeping the grounds in presentable condition. The rents are from \$3.00 to \$3.50 per week. As the cost was \$2,250 per tenement, and much more than this for the recently built houses, there is little direct profit to the company, after water rates, insurance, repairs, and depreciation are covered. There is, however, probably no other body of wage earners in the United States who live in equally beautiful surroundings.

The rental policy appears to be indicated for two sharply contrasted cases: first, where accommodations must be provided for a shifting force, representing the wage-earning element of a low-grade population, without sufficient thrift or resource to aspire to home ownership; second, where a very high grade population is to be accommodated, so that central management of real estate plotting and domestic architecture is resorted to as a means of obtaining the aesthetic charms of a *rus in urbe*.

Houses to sell. — The building of houses to sell fits the intermediate case. It has the advantage of stimulating home ownership, of contributing strongly to stability of force, and of providing the individual family with a better planned house and better structural values than can be gotten when houses are built one by one, through contractors. Employees are also protected from loan sharks, bad-title frauds, and the high interest rates of most instalment plans. The N. O. Nelson Manufacturing Company of Leclaire, Ill., builds houses on plans agreed upon between the firm and the employees. It charges for them the cost of the material and labor, and a percentage of profit equal to the average earned by the business as a whole. Of this plan the United States Bureau of Labor says: "As the firm has its own planing mill and woodworking force, the net cost of a house to the purchaser is considerably less than if bought in the usual way. Payments are made monthly, the amounts varying from \$12 to \$20, accord-

ing to the price of the house, the wages of the buyer, and the size of his family. . . . In the event the purchaser desires to remove and dispose of his property, the company voluntarily refunds the amount paid for the house, after deducting therefrom rent for the time occupied."[1]

The boarding house problem. — In rare instances employers have attacked the problem of the living conditions of single employees. If a manufacturer in a small place requires more single men or women than the population of the locality affords, and if the wages he can afford to offer are not sufficient to attract young people from nearby towns, where they live at home cheaply with their parents, he may be forced to take steps to improve the purchasing power of his wages, by reducing the local price of board and rooms, or by raising the standards of boarding house comfort. Unmarried wage earners away from home must, as a rule, live as boarders in the families of the less thrifty workmen, occupying unheated, desolate little rooms, and being deprived of adequate facilities for entertaining friends or enjoying home recreations.

The Waltham Watch Company of Waltham, Mass., operates a large girls' club or rooming and boarding house, where women employees can secure accommodations at a very moderate price. The same company controls a men's boarding house with slightly higher rates. Care is taken to avoid giving the impression that the company desires its employees to live in these houses. The accommodations are sufficient for a part of the unmarried force only. What has been done serves, however, to regulate private rates and to elevate standards of comfort.

Education. — The types of educational work which employers do most frequently may be enumerated as follows: (1) elementary schooling for adults whose education has been entirely neglected, (2) continuation of schooling for youths who have dropped out of the public schools at an early age to contribute

[1] G. W. W. Hanger, Housing of the Working People in the United States by Employers, Bull. of Bureau of Labor, Sept. 1904, p. 1215.

to the family earnings, (3) vocational training as a substitute or supplement for apprenticeship and, (4) the provision of miscellaneous opportunities to improve the intellectual activity of the force as a whole.

Elementary schooling. — The American public school system leaves little occasion for employers to participate in elementary education, except in the South, in the interest of mountain whites, and in the North, for the communication of the three R's to adult immigrants. The Pelzer Manufacturing Company of Pelzer, S. C., supports a large elementary school of over 700 pupils, which runs for nine months in the year. It also supports a kindergarten in a separate building, with an enrolment of 150 children. Both of these schools are free. As a condition of employment with the Pelzer Company every parent is required to sign a statement agreeing to send all members of the family between the ages of 5 and 12 to school regularly, health permitting. The reason for this is that, until 1915, there was no compulsory school law in South Carolina. The practice is still continued, since the new law is ineffectual, its operation being left to the vote of each school district, and no provision being made for a truant officer. Every child who attends the company's school for a month without absences is given 10 cents. When this mill town was opened, 75 per cent of the adults were illiterates; the proportion has now been reduced to between 15 and 20 per cent.

An illustration of the problem of educating the immigrant may be seen in the Ford Motor Company's plant at Detroit, where many elementary classes are being instructed by volunteer and unpaid teachers from the force. Out of the 30,000 employees of the home plant, about 80 per cent are of foreign birth. The leading foreign nationalities are, in the order named, the Polish, Russian, Austrian, Italian, Hungarian, Roumanian, German, and Jewish.

Continuation schools. — The school plan operated for some years by the N. O. Nelson Company of Leclaire, Ill., was

unique. At 12 years of age the boys in the neighborhood were admitted to the school and shop. They were obliged to devote one hour per day to work in the company's factory, or on its farm. For this work they were paid. The remainder of the day was spent in school. As the age increased the amount of work required increased and the study period decreased until, at the eighteenth year, the boys graduated from school. A special class was provided for boys 16 years of age or older, who were admitted from outside localities. Such boys could get half-day schooling, and were required to work for the company the other half day. In return for this work the company paid the expenses of board, lodging, and schooling. The plan was abandoned for the reason thus given by Mr. Nelson: "My design was to educate young men, in the shops and on the farm, to make a living by manual labor, and at the same time give them as much school education as they would take. We found that nearly all who came to the school did so with a view to getting a literary education, for the purpose of getting away from manual work."

Apprenticeship schools.[1] — With the decline of apprenticeship, caused by the subdivision of the trades and the more

[1] Most of the great railways have, since 1905, established apprenticeship schools at points where shops are located. Among manufacturing concerns having shop schools mention may be made of —

The American Locomotive Company, with schools at 7 points.
Brown-Sharpe Manufacturing Company, Providence, R. I.
Cadillac Motor Car Co., Detroit, Mich.
Consolidated Gas Company, New York City, N. Y.
Fore River Shipbuilding Company, Quincy, Mass.
General Electric Company, at West Lynn, Mass., and at Schenectady, N. Y.
R. Hoe and Company, New York City, N. Y., with a school established in 1872.
International Harvester Company, Chicago, Ill.
Packard Motor Car Company, Detroit, Mich.
Solvay Process Company, Solvay, N. Y.
United Shoe Machinery Company, Beverly, Mass.

exacting schedules of power-driven manufacturing, some of the larger employing concerns have turned to school methods of instruction, as a means of maintaining standards of craftsmanship. Shop schools are conducted at the plant, usually during business hours, the time spent by the pupil in study being paid for at the same rate as other working hours. Sessions occupy on the average 3 or 4 hours per week; the courses extend over a period of from 2 to 4 years. The instructor is commonly selected from the force, and devotes but a portion of his time to teaching. The studies, which generally presuppose seventh grade attainments, relate closely to the shop craft or office work toward which the student is directing himself. The subjects most frequently chosen are English, mathematics, mechanical drawing, and shop processes. Text books and written examinations are not unusual. The pupil is usually bound by an agreement or indenture with reference to the term of employment.

Miscellaneous intellectual opportunities. — A great variety of educational or inspirational activities may be discovered by reviewing what progressive employers are doing. While these efforts are not sufficiently systematic to deserve the name of schooling, they yet serve to awaken and intensify the mental activity of employees, to reveal the hidden arts or points of superior technique connected with the day's work, or to reveal standards which will elevate the general manner of living. Among the means employed may be mentioned, noon shop

Western Electric Company, Chicago, Ill.
Westinghouse Electric and Manufacturing Company, E. Pittsburg, Pa.
Yale and Towne Manufacturing Company, Stamford, Conn.

Office schools are conducted by the —
Burroughs Adding Machine Company, Detroit, Mich.
Curtis Publishing Company, Philadelphia, Pa.
Equitable Life Insurance Company, New York City, N. Y.
National City Bank, New York City, N. Y.
National Cloak and Suit Company, New York City, N. Y.
National Surety Company, New York City, N. Y.

talks, educational moving-picture films, circulating and reference libraries, study clubs, an employees' magazine, and educational trips to other establishments.

Clubs.[1] — Social advantages are distributed with extreme unevenness in any community. A few persons are blessed, and even over-blessed, while the majority lead lives which are starved from lack of variety of human association. The size of modern communities has become such as to bring about a regional separation of the classes. The mobility of labor is constantly breaking up neighborhood ties. The church is no longer, as once, the social center for all classes. The only point at which the gifted and non-gifted are brought into permanent contact is within business organizations. Here there are those with leisure, means, friends, and administrative ability who are qualified for social leadership: and here also are those who lead monotonous and lonesome lives. This contact creates an opportunity and a social duty. By a little organization,

[1] Among the firms which have built club houses for their employees are —

The Boston Edison Company.
Brooklyn Rapid Transit Company, Brooklyn, N. Y.
Commonwealth Steel Company, St. Louis, Mo.
Howland Croft Sons and Company, Camden, N. J.
Illinois Steel Company, Joliet, Ill.
International Harvester Company, Chicago, Ill.
Maryland Steel Company, Sparrows Point, Md.
National Cash Register Company, Dayton, O.
New York Edison Company, New York, N.Y.
New York Telephone Company, New York, N.Y.
Peacedale Manufacturing Company, Peacedale, R. I.
Plymouth Cordage Company, Plymouth, Mass.
The Pocasset Worsted Company, Providence, R. I.
Solvay Process Company, Solvay, N. Y.
United Shoe Machinery Company, Beverly, Mass.
Vermont Marble Company, Proctor, Vt.
Weston Electrical Instrument Company, Newark, N. J.
J. H. Williams Company, Brooklyn, N. Y.
Witherbee Sherman Company, Mineville, N. Y.

the pleasures of human companionship may be made a transforming power in many lives.

The purpose of an employees' club is to exploit the social resources going to waste in an industrial group, by the formation of recreation groups, such as vacation clubs, athletic clubs, dancing classes, and dinner clubs; by the formation of joint-consumption groups large enough to purchase entertainment on a reasonable basis; and in all ways which will enlarge the variety of helpful interchange of thought and impulse between individuals.

A club, by the formality of election of its members, creates an atmosphere of selectness and solidarity which promotes acquaintance and mutual confidence. By its dues it banishes the thought of patronage. By its election of its own officers, and its self-government under a constitution and by-laws, it suggests democracy, responsibility, and independence from outside dictation. By the ease with which a variety of functions can be carried on through various committees, it is fitted to be the comprehensive agency which binds the various non-productive activities of an establishment into an organic whole.

The chief function of employers in connection with employees' clubs is to provide the quarters. An unused corner of a shop may be fitted up as a game room and place for committee meetings. An attic floor, or a portion of a warehouse, somewhat remodelled, may be used at noon for a lunch room, and in the evening be converted into a hall for lectures, concerts, amateur theatricals, dances, dinners, and social gathering. An independent building serves to give an organization a more tangible and distinctive existence. If to a club house there is attached a recreation field, those who prefer indoor amusements can count on the coöperation of those who love outdoor sports, so that the activities of the society need not go into a decline during the summer months.

Difficulties. — The Eagle and Phoenix Club of Columbus, Georgia, was maintained for some years by the Eagle and

Phoenix textile mills of that city; the membership being confined to employees. The club occupied a house provided by the mills. Dues were 15 cents per month. The money so obtained was used exclusively for entertainments. These were held weekly and consisted chiefly of dances and suppers to which the women relatives of the members were invited. There was, also, a lyceum course of lectures in the winter, to which admission was by ticket, each member having three tickets. There was a library, and there were study classes in English, mathematics, and elementary branches. Music lessons and dancing lessons were also given. A gymnasium, with free baths, was in charge of a physical director. Any deficit which occurred was made up by the company. The patronage of this club declined after a few years, until the project had to be abandoned. The cause of failure, as given by Mr. J. D. Massey, Treasurer of the company, was that there did not at the time exist a sufficiently high level of primary education among the employees to enable them to appreciate the facilities offered them. It is hoped that the excellent public schools of Columbus will, in a few years, so change the conditions that a club enterprise may again be inaugurated.

The difficulty of making even an elaborate equipment ensure success may be illustrated by the efforts of the Celluloid Company of Newark, N. J., on behalf of the Celluloid Club. In 1889, the company built for this club a fine three-story home, at a cost of $40,000. The basement of the building contains 4 slate bowling alleys, a pair of rifle ranges, a game room, lockers, and boiler room. On the first floor are hall, reception room, billiard room, cloak and bath rooms, lavatories, business office, café, and kitchen. On the second floor are the reading room and library, ladies' reception room, and card room, besides officers' quarters and committee rooms. The entire third floor is taken up by an auditorium having a seating capacity of 500 people, and equipped with stage and dressing rooms. The members of this club pay no dues whatever, the com-

pany furnishing and maintaining the building. At noon the café serves a luncheon at cost to members. Once a month there is a general entertainment or dance. A variety of activities is promoted, the most successful of which are a savings and loan department, and an insurance department. This club, which was very popular in its earlier years, has been recently somewhat neglected by the employees. One reason assigned for this is that the club house is not at the works, and consequently is not convenient for use at the noon recess. Another reason may exist in the general conception of the institution, which is that of a business man's club.

The traditional conception of a club based on the habits of the "club man" is a delusion and a snare in the planning of employees' clubs. By following it, equipment may be so elaborated that people accustomed to simple things feel un-at-home. The emphasis which this ideal places upon drinking and lounging does not accord with the wage earner's philosophy of life. Finally, a man's club neglects the family, the leavening of which with a new life is the chief opportunity of an employees' club.

Acquaintance. — The activities of a club reveal men and women to each other in a way entirely different from the routine of business. By bringing out something besides the work side of character they provide a better basis for coöperation, even in business. They serve to bring together officers and employees, and to cut across department lines.

Recreation. — The recreation most appreciated by young women is dancing for indoors, and tennis for outdoors; that most in favor with men is billiards for indoors, and baseball for outdoors. All of these recreations require expense and so organization. The effectiveness of recreation as a form of recuperation lies in its power to divert attention to fresh muscular and nervous centers, and to suspend the motor and sensory activities which have to do with fatigued muscles. For brain workers, its value lies in its power to excite fresh centres in the

brain, and so wholly divert conscious and mental activity, and partially divert subconscious activity, from fatigued areas. In this scientific age we are suspicious of the wholesomeness of natural impulses unless a scientist steps from his laboratory with proof of utility. Let us, therefore, quote a prime authority. "A prolonged flow of happy feelings," says Geo. J. Romanes, "does more to brace up the system for work than any other influence operating for a similar length of time." As Dr. Lauffer says, "We may use an area of the brain smaller than a silver dollar in our usual vocations; to get rested we need avocations, so as to employ a larger area of the brain cortex. We overheat one set of wires, so to speak; we rest up, not only by allowing those wires to cool, but by heating another set, which more completely diverts the attention from the cooling set." [1]

The warfare with drink and vice. — The club, being a chief means by which recreation can be secured, without paternalism and undue intermeddling, is a competitor of the saloon and public dance hall. The welfare department of the Colorado Fuel and Iron Company has had to deal with the characteristic population and habits of mining towns. It has for years waged an unrelenting warfare against the saloon, using all conceivable agencies, such as soft-drink clubs, restricted wet clubs, reform saloons, and regulated saloons. Its nearest approximation to success was, perhaps, with the Coalbasin Club. This organization was well housed in a club house, provided with the usual sanitary and amusement features. It sold soft drinks at low rates. It also sold liquors, but under the restrictions that they must be pure, that they must be sold at a good profit, that the bar must not be located in or close to the lounging room, and that the club rule of no treating must be strictly enforced.

Development of initiative. — A club offers to its members a chance to exercise their own initiative; hence it gives the vigor of freedom in action, and the pride of ownership in accom-

[1] Dr. C. A. Lauffer, Standardized First Aid, Rep. of Second Convention of Nat'l Asso. of Corporation Schools, 1914, p. 620.

plishments. After an extensive experience with welfare work, the National Cash Register Company of Dayton, Ohio, found it advisable to abandon most forms of office-directed enterprise, and place responsibility in the hands of two clubs, the Men's Welfare League, and the Woman's Century Club. When Senator Proctor of Vermont dedicated a $30,000 club building to the men of the Vermont Marble Company, he said, "Men prefer to care for themselves, and spend their own money — the money they have earned — in their own way. Give them a good chance to do this wisely and properly for their own moral, intellectual, social, and physical welfare, and this is the greatest help the employer can render them."

Beauty in the industrial environment.[1] — Art has often been looked upon as something expensive, appropriate to adorn a wealthy man's home. It has been treated as an esoteric mys-

[1] Among the many manufacturing concerns which are eminent for the beauty of their structures are —

The American Colortype Company, Newark, N. J.
American Electric Heater Company, Detroit, Mich.
H. Black and Company, Cleveland, O.
Brewster and Company, New York City, N. Y.
R. Donnelly and Sons Company, New York City, N. Y.
Ford Motor Company, Detroit, Mich.
Ginn Publishing Company, Cambridge, Mass.
Hersey Manufacturing Company, Boston, Mass.
W. M. Hoyt and Company, Chicago, Ill.
Hudson Motor Company, Detroit, Mich.
Lever Brothers, Cambridge, Mass.
National Biscuit Company, in several cities.

Some of the firms which have attained beauty of grounds are —

The Dennison Manufacturing Company, S. Framingham, Mass:
Gorham Manufacturing Company, Providence, R. I.
National Cash Register Company, Dayton, O.
Plymouth Cordage Company, Plymouth, Mass.
Sears, Roebuck and Company, Chicago, Ill.
Walker Pratt Company, E. Watertown, Mass.
Walter Baker Company, Milton Lower Mills, Mass.
Doubleday, Page and Company, Garden City, L. I., N. Y.

tery or secret doctrine to be concealed in libraries and galleries, and revealed only to those with long hair and strange manners. But we are slowly beginning to learn by experience what we might have learned quickly had we read how people treated it in Athens, Florence, and Antwerp, namely, that art is to embellish the environment of daily life, and give worthy expression to the things we held most dear. It is something to surround ourselves with for the pure enjoyment of it, and to use for the utility's sake. Psychology is teaching us that artistic things are restful, working a magic of nervous economy through the sense of fitness they produce.

Surely that is utilitarian which produces much pleasure at little cost. A beautiful building may give a minute's pleasure each day to 50,000 passers in the street, and so produce from 800 to 1,000 solid hours of human happiness for every 24 hours it stands. An outfit of window boxes, gay with flowers throughout a summer, may transform a gray, gaunt factory into a place that seems like home for a couple of hundred women employees, and do this for an outlay of a few dollars. If this cheap utility, and this tonic of pleasure is to be enjoyed by the majority of persons, it must come to them by snatches in the hours of work. If art is to be made democratic in a country where industry prevails, it must transform the industrial environment. The place for beautiful things is where they will be seen. A rich stained glass window glowing in the afternoon sun in the end of some great erecting shop is a hundred-fold more useful than locked away in the nave of a silent church. And more appropriate, for it can only "glorify God" by refreshing the human spirit. "As we journey through life, let us live by the way."

Responding to such thoughts as these, we find American employers, like the Kodak Company, planting vines to cover the brick walls of their buildings, the National Cash Register Company employing an expert to landscape their grounds, the H. J. Heinze and Company putting beautiful windows on their

stairways and hanging paintings on their walls, and the International Harvester Company providing band concerts at noon for their employees. When it is observed that, in our great cities, the banks and office buildings are borrowing from the classical temples, and that the larger stores are ornamenting their departments like galleries of art, it seems not impossible that a renaissance of art may develop under the patronage of industry in this "land of boundless possibilities."

Landscape gardening. — A great impulse toward the introduction of art into daily life has come through the arrival of the most inexpensive and democratic of all arts, namely, landscape gardening. This art escaped some years ago from our cemeteries into our public parks, converting them from bare meadows and raw woodlands into gardens beautiful with flowers and fountains and bathing pools and boating lagoons and play grounds. It is now being taken to the homes of the people, and there simplified to frame in the lawns with shrubbery borders and hide unsightly objects. As the home grounds take on a more attractive appearance, people are being coaxed out of their houses into sun parlors and living porches and pergolas, and are learning to unite the indoor and outdoor divisions of the home life into a new unity, through a recreation which combines art with nature, and aims to paint landscapes in real materials.

Is there any reason why the streets and homes and parks of the American city should be made beautiful, but the buildings and grounds where the workers of the community spend their days should remain ugly? "Life without industry," said Ruskin, "is guilt; industry without art is brutality." As a result of the competition of American cities for population and new industries, it has at last been noticed that the railway lines, from which the travelling public views a city, are usually borered with industrial establishments so that, if these buildings are ugly, and their grounds neglected, the impression goes out that the community is poor and its people lacking in education.

Art and expense. — The beautification movement is not one which calls for great expenditure. The prerequisites of beauty are cleanness and appropriateness. Factory rooms may be made attractive by painting the walls and ceilings with cheerful tints, and by decorating with simple stencil patterns or with large lithographic, or even poster, reproductions of works of art in colors. The beauty of a building consists rather in the proportions of the larger masses, and the rhythm and balance of the individual parts, and in the color harmony of the materials used, than in any specific ornamentation. For ornamentation, indeed, nothing excels vine-covered walls and window boxes.

The grounds about factory buildings and the fences enclosing them exercise an important determining influence upon general appearance. If the inside walks and drives are skilfully laid out, and yard storage is made compact and systematic, it will be possible to put considerable areas into lawn, redeeming them from dust and the heat and glare of sunshine reflected from bare earth. It is the function of shrubbery to emphasize unity and privacy by raising a wall of green at the property boundaries, and by softening the harsh angle made where building walls spring from the earth. Tree planting will serve to screen disagreeable objects, and give the effect of varied topography. Flowers, if used with the greatest economy, will be massed at gateways and doorways, where the beauty of individual plants may be appreciated, or will be distributed here and there as narrow bands in front of shrubbery borders, to form a ribbon of contrasting color across the landscape picture.

Policies. — The following propositions with reference to welfare work appear to be warranted by experience:

1. Wages must be equal to those paid elsewhere for equal service. It is unwise to make such a lavish expenditure as to generate the thought that, if the employer can afford to do so much, he might raise wages.

2. One thing should be undertaken at a time, and that the

most essential thing. The way for each move should be carefully paved, so that the intent of the management will be understood. The development of enterprises should not be allowed to outrun the power of readjustment and response of the employees, upon which depends the utilization of the opportunities provided.

3. As rapidly as possible, managerial responsibility should be transferred to the employees. We never prize what others do for us as we prize what we have achieved for ourselves. The diplomatic rôle of the employer is to be the power behind the throne.

4. Physical conditions will demand attention before schooling or art. Tired, dirty, and imperfectly nourished bodies do not respond well to books and lectures and the play instinct.

5. Home conditions and the outside life must finally be brought into harmony with the life it is hoped to create at the works, otherwise the one will continually undo the achievements of the other.

6. No conditions should be allowed to develop, under the guise of welfare work, which will destroy the discipline and efficiency essential to provide the financial wherewithal.

Difficulties. — It is not easy to make a success of welfare work. There are many projects to choose from, and innumerable ways of proceeding. There are many kinds of people and there is an infinite variety of local condition. There will inevitably be some embarrassment for employer and employed in finding a footing in matters where orders are out of the question. Workmen have well defined opinions about the conduct of their lives; and into contact with these opinions any plans which go beyond customary industrial practices are bound to come. It is natural that there should be a heritage of suspicion descended from the time when employers planned entirely for their own profit. It is natural, also, that trades unions should be cold toward benefits which the employer has the power to withdraw at a moment's notice.

Conclusion. — It is the normal method of progress that the refinements of life should first be enjoyed by the few, then extended to many as a favor, and at length demanded by all as a right. Welfare work is the beginning of a new form of competition between employers, which is addressed to their employees, and is concerned not so much with direct wages as with the indirect wages of the character of the environment which makes the life at work attractive or the reverse. This competition is now sufficiently developed so that the standard forms of welfare work exert an influence in attracting superior employees, assuring greater permanence of force, and creating a spirit which brings better service.

Beyond the limits of competitive calculation welfare work pays, for the simple reason that it is agreeable to be surrounded by fit and beautiful things, and to spend the working hours of life among friends. The field of welfare work presents an opportunity of leadership for a man of culture or of unusual dynamic power, in matters which lie beyond the minimum of decency which competition forces out of the ruck of capitalists.

It is an effort to bring production and consumption into more intimate contact; an effort which is justified by the observation made by all men of penetration, namely, that a large part of the really fine opportunities for spending grow out of the association of men together in producing. In the past many men have taken wealth out of industry, leaving behind ugly factories and miserable workers, and have spent their means in fields where they were amateurs, doing many fine things and many foolish things in art and charity and education. There are now men who are determined to see what can be done in perfecting and beautifying the life in industry itself.

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CHAPTER XVI

OFFICE DEPARTMENTS

The nerve centre. — It is necessary to form a corps of personal assistants about the chief administrators, and to provide equipment of a special character, so that the nervous energy of the leaders — the most precious thing in an organization — may be conserved and utilized in an efficient manner. The office corps has laid upon it the duty of anticipating the needs of the executives for detailed information, and of applying to minor and routine matters the principles which have been established by general orders or confirmed by the force of custom. It is the chief function of the office staff to deal with records; producing and reproducing them, sending and receiving them, and inspecting and filing them. Some of these records will have for their purpose to give direction to shop and field activities, others will form a part of the system of accounts used for compiling an exact record of values, and still others will chronicle the relations of the organization with the outside world, as established by contracts, correspondence, and interviews. In handling these records, the office acts the part of a nervous system of an organism. Its labors are not "unproductive" any more than the work of the spinal cord and the motor and sensory nervous system, which connect the brain and the muscular fibres of the body, is unproductive.

Personnel. — In ordinary practice the number of persons in the office force will average about one to twenty of the shop or field force. The payroll will be in the neighborhood of $1.00 to $10.00 of the other departments. The clerical force may be

said to surround the leading executives like a cloud. If it is not composed of well chosen persons, it may form a screen, hiding the leader from his operatives, and misinterpreting him to them by irritating acts of arbitrariness and red tape performed in his name.

Not every one who makes an exceptionally good record in shop or field work can succeed in the atmosphere of an office, and so pass successfully by way of bureau work to the higher executive positions. Nor is the born leader, who lives in a world of large ideas, and who succeeds chiefly by communicating his enthusiasm to others, a person necessarily fitted to organize the details of an office. There is a special technique in office work; and there are certain temperaments which best adjust themselves to it. For the ideal chief clerk there is required tact without servility, patience and accuracy in matters of routine without lack of general comprehension, and the power of organizing details into a system, without that fanatical insistence upon form which often accompanies system and which leads to red tape.

Misuse of the clerical staff. — Those who stand near to overloaded executives are very apt to fall heir to neglected duties. A careless administrator may easily fall into the habit of allowing a clerk to sign his name to letters he has not passed upon, thus in effect creating an understudy without sufficiently considering the step. Such a practice is likely to lead eventually, at some time when the officer is absent from his post, to the ridiculous situation of high-grade field officers or department heads taking their orders from a clerk or private stenographer. In this way the slovenly habit of delegating authority on the basis of mere proximity may encroach upon the principle of delegating it on the basis of competence. One of the problems of office administration, therefore, is to prevent the wedging in between high executives of some person of mere clerical rank, whose proper function is not administration but record keeping.

Office versus field. — An office is engaged in handling ideas. It deals with representations of things rather than with the things themselves — with ideas stripped of their proper sense-impressing embodiments, and only very faintly materialized by their written records. A problem of office work is, therefore, to render vivid to the bureaucratic mind the real consequences of office shortcomings, as those consequences develop at a distance and a later time, in the shops, or the sales agencies, or elsewhere in the field work. There are needed means of impressing the clerical mind with the tediousness to outdoor men of filling out elaborate reports, or with the exasperation of technical experts at orders which are out of touch with the situation. A clerk may make a careless omission from an order, and the error will seem a small thing on paper, unless he is able to realize that it may translate itself into tons of materials shipped to the wrong station, or a gang of men idle for lack of some essential piece of apparatus, or long lines of teams waiting while foremen dispute as to the meaning of ambiguous terms. Unless the work of the office and the field can be kept in sensitive adjustment, the law of the primary productive process may be made to give way to some petty rule — or error — of record making, and thus the tail be allowed to wag the dog. If a preliminary field training can be provided for office candidates, or a tour of duty can be arranged to make field and office work alternate seasonably, or if a system of conferences can be arranged to bring office men and shop men into intimate association, records can be given a vivid and pungent significance for the office force.

The problem of attention. — In the shops and in field work, where productive processes of a physical nature are going on, the progress of work is accompanied by the movement of certain objects, and by a characteristic succession of sounds. In the successive stages of a task the workman's body assumes different postures and his hands come in contact with different objects. A varied stream of sense impressions, therefore,

pours in upon the workman's brain, and assists him to keep his mind fixed upon his task. And if his attention wanders, a change in some one of the physical conditions presently recalls it, and gives to the returning thought a prompt grasp of the state of affairs.

The labor of office work, on the other hand, must be carried on without these powerful aids to attention. It deals with a flow of ideas more or less completely embalmed in a monotonous collection of written or printed papers. The accompanying physical process is an exceedingly subordinate matter: it is uniform and deadening, and lacks that dramatic and attention-arresting character which physical labor possesses. Most of the sense stimuli received by office workers from sounds and moving objects tend rather to draw the attention away from the task, than concentrate upon it. To hold the attention against the pull of interest requires an effort of will. Such an act of attending is not involuntary but voluntary; it is highly exhaustive of nervous energy. Under ordinary conditions the office man is quite as much exhausted by what he restrains himself from doing, as by the useful labor he accomplishes.

Special effort should be made to defend office workers against distractions. This may be done by suppressing useless noises, by shutting out the sight of moving objects, by eliminating glare, and by making constrained positions of the body unnecessary. The various by-paths down which attention might wander as a truant must be closed. Much also can be done, in a positive way, to make concentration easy by giving instruction in the psychology of attention, by increasing the significance of work, and by giving appropriate physical expression to tasks.

Noise. — The problem of noise is growing in importance. The increase of city congestion, the greater number and speed of vehicles, the paving of roadways with hard resounding substances, and the walling-in of the streets with lofty buildings whose fronts reflect sound as do the sides of a cañon, have con-

spired in recent years to make conditions in office sections distinctly less favorable to mental concentration. The inside conditions have also grown worse. As Dean W. C. Sabin of Harvard University, the leading American expert on acoustics, has said, "The whole development of building construction and building materials, during the past twenty-five years, has been in the direction of poor acoustics and more and more noisy offices. Recent efforts at fire-proof construction have resulted in the use of harder and harder wall surfaces, with consequent increase in reverberation. The plaster, too, is usually applied directly to the tile or brick walls, and is much heavier and denser than the old hair-lime-mortar plaster. As a result we have exceedingly noisy rooms."

Among the remedies for noise are, heavy building construction, tight windows (forced ventilation being used), floor coverings of rubber or cork or carpet, and sound-absorbing coverings for walls and ceiling. Dean Sabin has shown that a layer of hair felt $1\frac{1}{4}$ inches thick, placed on walls and ceiling, will absorb about $\frac{1}{4}$ of the sound of lower C reflected against it, about $\frac{4}{10}$ of the sound of middle C, and over $\frac{2}{3}$ of higher C.

The nature of attention. — Every mental worker should be instructed in the nature of attention, so that he can analyze himself, and can learn to take the necessary precautions to protect himself against his own weaknesses. He should be trained to the habit of closely pursuing the heart of a matter, by asking himself repeatedly: "What has already been done?" "What is the next step?" Bacon said in his Essay on Despatch, "Iterations are commonly loss of time. But there is no such gain of time as to iterate often the state of the question."

The significance of the task. — The strain of controlling the attention is lessened by anything which enlarges our understanding of the general value of the work we are doing, or which confirms our belief in the personal profit of it to us. Office work can be illuminated with significance to the employee

by relating it to other things, showing how it controls the shop and field processes, how it records and judges them, and how it searches out the signs of their efficiency or inefficiency. Interest may also be awakened by relating the present with the future. Anything which leads to a clearer perception of the connection between one's present work and one's future welfare, or which reveals the way in which one's individual accomplishments unite with the labor of others to form a result which is great enough to awaken pride and devotion, will command the attention. Finally, all true labor can be invested with interest by being related to the worker's own personality as a test of himself, as an emulation with others, as a form of self-expression, or as a contribution which makes one a force in the world-wide struggle for technical efficiency, artistic form, or moral achievement. Drudgery is work done when the mind is shut in by ignorance. It is the duty of management to strike off the shackles of this drudgery, by revealing the things which are worth while in the work.

Arrangement of office departments. — The first step in determining the space required for office departments is to ascertain by methods analogous with those used by scientific management in the shop, how much an employee should be expected to do in a day. The experience of office managers now indicates in a general way what this is. It is held, for example, that in an hour 200 letters can be opened and read sufficiently to determine the department to which they should be referred, that 200 orders of five items each can be entered in an order register, that 100 square inches of typewritten work can be accomplished by a $10.00 per week girl, and that 2,800 items can be handled on an adding machine.

The next step is to determine the various kinds of work which will have to be performed, and the amount of each, thus giving a criterion as to the number of persons required. The third step is to calculate the space requirements; the general rule being that office space runs about 100 square feet of floor per

employee, including the allowance which must be made for aisles and furniture.

Spacial units. — The usual space elements of office departments are, the general files, the vaults, the correspondence department, the accounting department, a series of private offices for chief executives, and the reception and aisle spaces. If we assume that an office is to occupy the corner of a building, with light from two adjacent sides, a natural order of procedure in making locations will be as follows:

1. To place the files in the centre, on the theory that the most used thing should be at the most accessible point.
2. To devote the light of one side to private offices.
3. To give the locations nearest the light on the remaining side to the accounting and correspondence departments, the latter department being placed farthest from the centre on account of the noise of the machines.
4. To place the vault in the poorest lighted area.
5. To locate the reception space on an interior side next the hallways. Visitors tarry in this space but a short time, and while in it are not engaged in eye-straining work.
6. To determine the necessary passage ways, and the nature of the railings and partitions to be used.

A generalized scheme of office arrangement is illustrated in Figure 43, the areas artificially lighted during the day being indicated by shading.

Equipment.—On analogy with the revolution of shop processes brought about by the introduction of the factory system, there has come as a belated movement, a revolution of the mechanical element of office work. So far has this proceeded that it is now even difficult to reconstruct in imagination the office of a generation ago. Small dirty windows and smoky lamps then permitted but poor light. Cramped quarters and the absence of any intentional system of ventilation kept the clerks anemic. High tables and desks were provided at which workers stooped over ponderous volumes; when

sitting was possible, the only facilities provided were stools without backs. All records were spread in longhand with quills or steel pens. Each copy cost as much to make as an original. The permanent records were preserved on the pages

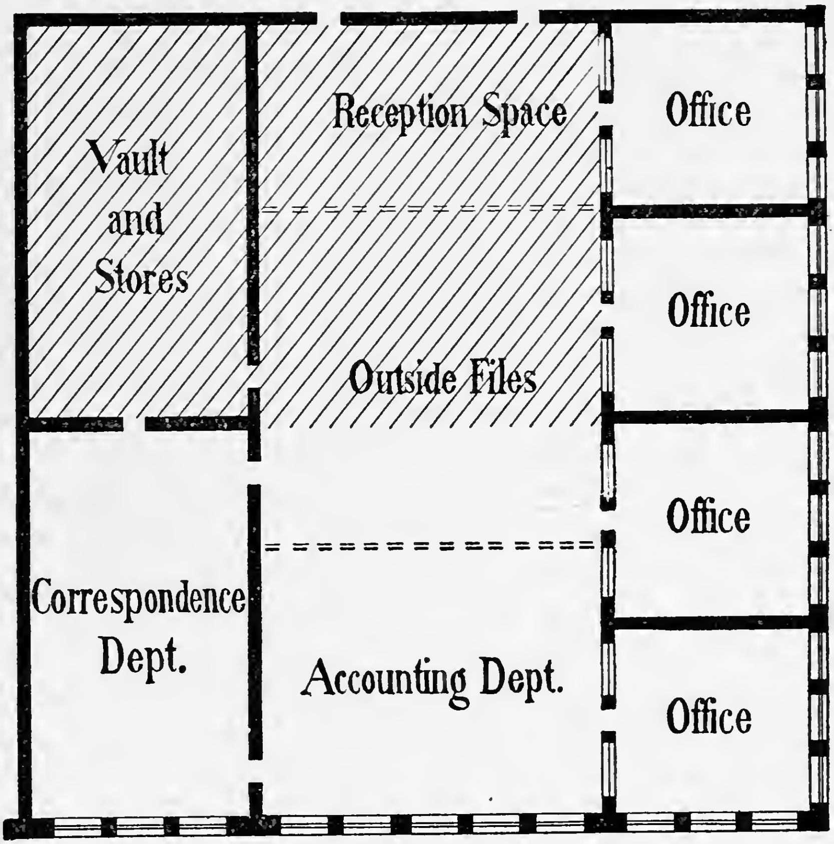

Fig. 43. A Plan of Office Arrangements

The shaded area will require artificial illumination throughout the day.

of unwieldy volumes, while temporary ones were scribbled upon the backs of envelopes and other scraps of paper, or found their way into a variety of odd-sized books. Everywhere there was lack of system and standardization, so that piles of confused documents covered the tables, and filled the drawers, and bulged from the pigeon-holes of desks and cabi-

nets. The members of the office force were repressed by being often reminded that they were unproductive laborers — a source of expense and not of revenue, and so a kind of necessary evil.

The ideals which have brought into existence modern conditions are:

Health giving surroundings — space, air, quiet.

All mechanical work to be performed by mechanism.

A complete and systematic documentary record of important matters.

A strict rule of "A place for everything, and everything in its place."

Standardization or interchangeability of parts in record keeping, on analogy with interchangeability of parts in machine construction.

Stenographic and phonographic records. — The first invention to definitely start the reform of office work was a more speedy method of recording the spoken word. The Phonetic or Pitman system of shorthand began to have general significance in England after 1840. One system only should be allowed in an office, so that stenographers can read each other's notes. Phonographic dictation claims the advantage of permitting all the executives to give their records in the first hours of the morning when the mail is being considered, while the transcribers can distribute their work on an even schedule throughout the day. The dictation can be at any desired speed. A source of error is eliminated by making the intermediate record between dictator and typewriter automatic. The President's Commission on Economy and Efficiency of the Federal Government calculated the average cost of letters by the two systems of dictation to be, for the stenographic 4.3 cents each, for the phonographic 2.7 cents each.

Reproduction of records. — The first practical typewriter was shown at the Centennial Exposition at Philadelphia in 1876. The introduction of machines into offices proved, at

first, to be very slow work, because satisfactory operators could only be secured through a prolonged course of training. The duplicate copy or carbon made on the typewriter has done away with the old methods of copying writings, introduced into this country from England by Thomas Jefferson, and involving the use of copy-book and press.

Paragraph dictation. — There is great economy of time and mental effort in constructing a series of ideal paragraphs covering certain subjects which it is found necessary to treat frequently in correspondence. These paragraphs may be designated by mnemonic symbols, and when so identified, can be used in dictation, interspersed with original matter, by simply indicating at the proper points the names or numbers of the paragraphs desired. Such standard paragraphs serve as a sort of intermediate resource between personal dictation and "form letters." Several paragraphs may be prepared expressing the same idea, so that distinctions as to fulness and tone can be made.

Report blanks. — The value of permanent records is obvious; the value of uniformity in reporting the same matters in similar cases is also obvious. Forms exert an important influence in the direction of securing uniform reports. By setting aside specific spaces for specific facts there are created reminders which will stand as blocks of blank white paper staring at the reporter until they are filled. If a report form is prepared and printed in advance, the writing required of the reporter may be reduced to a minimum by printing all the permanent parts of the record. By this means the practical range of report writing may be much extended into shop and field. Furthermore, printed reports may be made so compact and legible, and so portable, that the facts they contain are given greatly increased time and space utility.

Unit records. — The first system of unit records to come into general use was the card catalog of library science. This form of catalog was first used extensively in American public

libraries. The system of unit records, now having so many applications in business offices, has the advantage of permitting the concurrent use of various portions of the record — the different drawers, for example — by a number of people. It facilitates the introduction of new records, and the removal of obsolete matter, without interrupting the use of the live material. By the utilization of various systems of indexing — alphabetical, topical, chronological, and geographical — facts may be made almost instantly accessible, whatever the

Data which controls the filing	Data for sub-classification. Summaries and digests for quick reference.
BODY OF THE REPORT: This area to be more or less definitely broken up into appropriate rectangular areas which, as blanks, will remind the reporter of each element required in his report, and which, as records, will ensure speed in the use of the form, by providing a uniform location for each class of information.	
RESERVE SPACE: For suggestions, exceptional facts, matters difficult to classify above, or any pertinent additional data not planned for in the original layout.	

Fig. 44. GENERAL LAYOUT OF A UNIT RECORD

angle of approach. By the use of duplicate records and cross references, as many avenues of approach to the records may be opened as are desired.

The layout of a unit record. — The allotment of space in the planning of a unit record can only be indicated in a general way. The main subdivisions will usually consist of (*a*), a small upper left-hand space which controls the filing; (*b*), the remainder of the top space used for sub-classification, or for digests and summaries for quick reference; (*c*), the body of the report occupying the central space and (*d*), a blank space at the bottom for the entry of facts of an exceptional character, and for things left out by mistake in the original design of the form.

In designing forms which are to be filled out on the typewriter, care should be taken to conform to the mechanism of the machine. In transverse arrangement, the beginning points of all matter to be filled in by machine should be at the same distance from the left edge of the form, or at as few different distances as possible.[1] The beginning points can then be found with the automatic stop of the machine.

The vertical arrangement should be controlled by the line-spacing of the machine, so that work can proceed down the form from line to line, by simply rotating the platen.

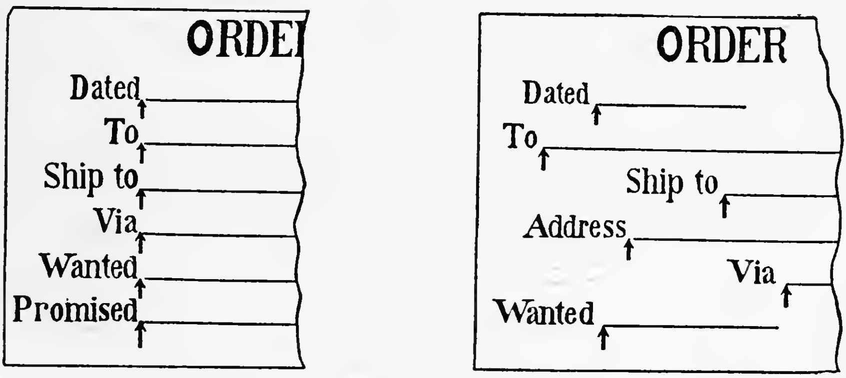

Fig. 45. Arrangement for a Typewritten Form

The arrow shows the number of different positions which must be found with the typewriter.

Unit records should conform to the sizes of paper adopted by the stationery trade as standard. Accurately-sized paper, cartons, trays, binders, drawers, and cabinets will then always be procurable promptly, and at moderate cost. The forms for field records, which are to be carried about in coat or hip pockets, and subjected to hard usage, should be compact and of tough stock, and should be protected by convenient containers, the covers of which will provide a firm writing surface.

Unit holders. — When records are filed in cabinets composed of an assembly of interchangeable units, it is possible to add to

[1] St. G. A. Bonaventure, Economy in Records, System, Feb. 1915, pp. 200–203.

or subtract from the width or height of the cases, to make room for growth by the addition of a unit at a time, and to take down or build up the files as may be required by changes of office arrangement or location.

The telephone. — A revolutionizer of office work worthy to stand in the same rank with the typewriter is the telephone. As the typewriter has superseded the amanuensis, so the telephone has superseded the errand boy. As the telephone is not yet supplemented by a mechanism for recording conversations, it is judicious practice to exchange written confirmations of oral agreements. In long-distance work the peculiar advantage of the telephone over the telegraph, or even the letter, is that it gives to each party an opportunity to adjust his mental attitude from instant to instant according to the words and intonations, and even the hesitations, of the other party.

Computing machines. — Ex-President Eliot has said that no person should be obliged to do work which can be as well done by a machine. Industry has already entered upon an era of economy of mental effort through the use of computing machines. The substitution of mechanical action for human toil in the petty computations of addition, subtraction, multiplication, and division will not only save time and cost in one element of office work but will open office positions to a class of persons previously debarred by lack of talent for rapid and accurate calculation.

The office desk. — The clerk's desk is as ubiquitous as the operative's machine, but unlike it has passed through a series of misconceptions. At various times in the past the office desk has been looked upon as a piece of ornamental furniture, as a warehouse for storing records, and as a safe or closet for locking up "matters pending" from the eyes of others. It is primarily none of these things, but a modified work bench, to facilitate the onward movement of documents rather than their storage or seclusion. A few years ago desks abounded in drawers and pigeon-holes which yawned on all sides to swallow up documents

and facilitate their delay. And these desks were barricaded on all sides with partitions raised above the working plane in such a manner as to screen the occupant from general supervision. The introduction of filing cases and of efficient filing systems has drawn most of the records out of private desks, and concentrated them where they are accessible to all. The desk is now solely to expedite current business: to pigeon-hole a thing has become equivalent to neglecting it.

Schedules. — As scientific management prescribes a schedule of operations for workmen and machines in the shops, and a routing system determines the travels of travelling salesmen from city to city, so an office system must plan an order of events for office workers. Where certain tasks have to be performed at regularly recurrent intervals, a working chart may be prepared. Such a chart may indicate to the cashier the day of the month on which certain classes of accounts are to be paid, to the bookkeeper when certain posting is to be done, and to the clerks when given collection documents are to be sent out.

Standard instructions. — The job sheets of the shops being out of the question for office work, instructions for the clerical force will usually consist of a body of standard and permanent orders. These may be gathered into a book of rules, similar to the manual used for instructing the sales force. A book of rules will give information on such matters as the prescribed hours of work, the method of reporting time, the order in which vacations are taken, permits for absence, the folders and packets which are to be used in desk work, rules of grammar and rhetoric for correspondence, the method of routing letters from department to department, the method of confirming and recording inter-departmental communications, and the manner of handling the documents of matters pending.

Motion study. — Mr. Frank B. Gilbreth has applied his skill in motion study to office work. As "eye-saving" devices he recommends[1] different colors of paper for documents with

[1] Third Biennial Report of the American Public Works Asso.

different destinations, the use of identifying initials on the corners of documents, and when several documents are to be brought together, the printing of the full list of related documents on each sheet. As "hand-and-foot saving" devices he recommends the printing of as much of each form as possible, the free use of self-inking rubber stamps, and the arrangement of files and furniture in such a way as to save travel.

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CHAPTER XVII

PURCHASING AND STORES DEPARTMENTS

The Census of 1900 informed us that nearly two-thirds of the cost of manufacturing, and over one-half of the gross income of manufacturing institutions were expended for materials, raw or partly manufactured. These large proportions make it plain why system and science should be applied in handling materials. The handling of materials involves the functions of purchasing, receiving, testing, warehousing, and issuing for manufacture, or shipping to customers. These functions are distinct from manufacturing and selling operations, and deserve separate administrative agencies. A subdivision may be made between a purchasing, a stores, and a shipping department, where the size of a business is sufficient to warrant it.

Purchasing

Administrative relations. — The purchasing of materials and supplies in a small business is likely to be handled by a general executive, who has many other things to look after. In a single-line industry, such as the manufacture of paper or flour or staple textiles, where the variety of materials to be bought is small, and where manufacturing operations are sufficiently routine to occupy only a portion of the executive's time, the same arrangement may exist. Even in very large concerns, like the leading railways, we find certain classes of purchases, such as of cars, rails, and locomotives, reserved for higher officials. In this case the reason is that the contracts are of such size as to raise problems of financing which must have the attention of headquarters.

In general, however, the work of purchasing should be entrusted to an officer who can specialize upon it. This is especially desirable where the labor problems and the mechanical problems are sufficiently engrossing to fully occupy the officers in charge of them, where a wide variety of materials has to be assembled, where the intrinsic value of materials is high or the proportion of finished product represented by materials is large, where an unusually long forecast of future requirements is essential, or where good buying is chiefly a matter of mercantile skill and knowledge of the state of the markets. As the market system of grading becomes more complex, through the recognition of sub-grades, and the multiplication of private brands, and as "over run" and "average run" of quality disappear and "skin grades" take their place, buying becomes more of an art. The purchasing officer has come in with the architect who designs buildings, the engineer who specifies machinery, and the employment officer who selects men. As sales managers elaborate their plans and lay hold of psychology, they must be met in the customers' organizations by purchasing officers who are able to hold their own with technology.

Opposing arguments. — There are various arguments used to oppose the creation of a purchasing department. One proprietor, for example, asserts that he never has any trouble in buying things, but only in selling them. If other proprietors were no more sensible than he, and did not put buying upon a more efficient basis, he would not have so much trouble in selling. It is equally to the point to say that the difficulties which a manufacturer encounters in selling may be due to the fact that his products are rendered unreliable by the use of improper materials, or are too expensive from amateurish buying or waste in the processes. There is also the argument that a purchasing department will increase the cost of materials. This point, which has its weight, of course, for businesses of small size, is not infrequently advanced for cases where there

is sufficient business to keep such a department profitably occupied. In such a case, the argument is on a plane with saying that an engineer increases the cost of power, an accountant the expenditure of funds, and a trained administrator the cost of administration. There is in this country, says Ex-President Eliot, a general habit of undervaluing the work of the expert. The principle of the division of labor, which is so universally understood with reference to manual operations, cannot be followed by many minds in its application to the work of service departments or the performance of administrative functions. There is another answer to the objection. To create a purchasing department does not originate any new functions without which a concern was previously able to get along. Purchasing has to be done whether there is a purchasing officer or not: a stock must be carried whether it is in a stock room or hidden away in the corners of the shops by the foremen; inspection has to be done either in advance, or with humiliation after an angry customer has returned defective goods. To organize a special department simply takes a group of responsibilities, which previously have been scattered around to annoy officers who are primarily interested in other things, and concentrates them upon a man who is specially fitted for the work, and who can gain expertness by continuous application to one thing.

A third objection is that of the foreman who says that a purchasing officer cuts you down on quantity, delays things, and finally gives you something different from what you had asked for. This is an objection to an inefficient purchasing plan. When properly organized the purchasing department exercises no control over either the quantities or qualities called for by authorized requisitions. If the purchasing officer discovers that unnecessary quantities or qualities are being used he has to establish the fact with the general superintendent. Any change in the materials specified for jobs will be on the orders of the latter. As for delay, experience shows that the

chief way of avoiding it is to concentrate responsibility on one person.

Functions. — It is not an uncommon thing to find that a clerk of purely office experience has been installed as purchasing agent, because it has been observed that a purchasing agent has an office, keeps records, handles correspondence, and administers an office process. The real work of a purchasing officer is to mediate between an outside market, ruled by commercial forces, and the shops of his company, ruled by technical considerations. He aims to serve the shops promptly with the materials wanted, at minimum cost, and yet buy in commercial lots and insert the minimum of price-increasing specifications into his buying contracts. He equates between a set of fluctuating price scales and a set of subtle quality scales. To take the best advantage of prices he needs to be an expert in quotations, discounts, datings, freights, packing, the reputations of suppliers, and the legal liabilities of the sale contract. To understand the quality scale he needs to know his company's products thoroughly. The clerical work he supervises is the smallest part of his troubles.

Limits of authority. — It is well to clearly define the field of the purchasing officer. Some of the restrictions which may be desirable in particular cases are:

1. Purchases to be made only on the requisition of the stores department, or of designated officers of the manufacturing and engineering departments.

2. Requisitions to be made only on the authorized forms supplied for the purpose, and to be signed by the proper officers.

3. Purchases to be regulated in such a manner as to maintain the supply of each article within the maximum and minimum stock limits set for it.

4. Various limits may be placed upon the amount of individual purchases or upon the rate of purchasing, such as (*a*), purchases not to exceed three (or six) months' average consumption; (*b*), total purchases in any one month not to exceed

—— dollars; (*c*), no single purchases to be made exceeding —— dollars, except with the approval of the general manager; (*d*), the purchase of designated articles or classes of articles, such as cars or locomotives in railway practice, to be reserved to higher officials. Such limitations avoid the creation of unusual current liabilities without the knowledge of the officers who will be responsible for making the necessary financial arrangements.

5. In the case of certain classes of articles the purchasing officer may be instructed to secure competitive bids, and to make purchases only of the lowest bidder.

Equipment. — Equipment may be inferred from functions. First of all, the purchasing officer should be provided with information concerning supplying concerns.

1. He should have a list of manufacturers and dealers supplying the articles regularly used, and of eligible bidders prepared to make any special products which may be required. This information should include the location of the plant and sales offices, the names of the officers to be dealt with, freight rates, average time taken in shipment, whether orders can be filled from stock or are to be manufactured, time required to manufacture, maximum size of orders which can be handled, general reputation as to honesty, promptness, and technical competence.

2. A file of catalogs of supplying houses should be collected. These may be arranged alphabetically according to firm name, with a cross-reference catalog according to articles; or they may be classed according to articles, with a cross-reference catalog of firms.

3. A record of prices paid should be kept, including all quotations, discounts, and datings offered, with careful notation of the authority for the information.

The purchasing agent will need a number of records with reference to the shops of his own concern:

4. The amounts of leading materials consumed should be

tabulated per month and year for some time past, to indicate how long a given lot will last. Knowledge of any special requirements cf the near future should be communicated to the purchasing officer in due time from the estimating department, or whatever authorities have the advance schedule in charge.

5. A record of the experience of the manufacturing departments with previous stock should be kept, so that there shall be no reorder of defective materials. All defects reported, and all percentages of waste, should be tabulated against batches of materials, and against the supplying firms.

6. If tests have been made of samples of untried materials, the record of these tests should be supplied to the purchasing officer.

With reference to the transactions of his own office, the purchasing officer should know:

7. What the size of the usual previous order has been.

8. What prices have been paid previously.

9. What delay in delivery, what shortage, or what departure from specifications has been experienced in dealing with certain concerns.

The act of purchase. — Purchasing involves the making of an original requisition, the placing of the order, the following up of the order until delivery is secured, the checking-in of merchandise as complete at the receiving office, the forwarding of the bill to the accounting department for payment, and the final payment.

Requisitions. — Mr. D. S. Kimball says: "The demand for materials grows naturally out of the needs of the business and cannot, therefore, originate with the purchasing agent. In a shop devoted to general repairs, the requisitions for materials would, most naturally, originate with the foremen in charge of work, since they will know better than any one else what is needed. In a shop building new work to order only, such as an engine works, these material requisitions for direct material

would originate in the engineering department, though they might pass through the storekeeper's hands before going to the purchasing agent in order to check off material on hand. In a shop manufacturing standardized articles, as knives, watches, etc., the material requisition would naturally originate in the stores department, which is the reservoir that feeds the factory, and here also would originate, always, the requisitions for all indirect and expense material. In a shop doing all three of these classes of production, therefore, material requisition might originate from several sources; and just as it is necessary to centralize the authority and responsibility of the purchases based on these material requisitions, so it is absolutely necessary to fix definitely the authority and responsibility of originating these requisitions."[1] Requisitions which cannot be filled within a reasonable time should be returned to the maker, accompanied by information as to when the material will be available. This will leave the way open for the resubmission of the requisition under the condition of delayed delivery, or the specifying of some other material, or the abandonment of the project entirely.

The order.[2] — The order is a legal contract and should be drawn with care. Its major parts are, the names of the parties involved, the description of the goods, the statement of the price with all terms affecting it, and the specification of the time and place of delivery. Where large affairs are involved it is convenient to prepare a model contract, elaborate it until all essential conditions are covered and the language has been made exact, submit it to a competent attorney for revision, and adopt it as the standard to be used in all cases where special conditions do not preclude. The clauses of such a contract should include —

1. A definition of the merchandise involved.

[1] Dexter S. Kimball, Principles of Industrial Organization, N. Y., 1913, p. 202.

[2] Compare Chapter XVIII, Selling, p. 367.

2. The statement of allowable variations in quality, quantity, or dimensions.

3. Date (or date limits) of shipment or delivery. Dates of, or rates per week or month of, shipments or deliveries.

4. An exact statement as to when title passes.

5. Price, with a statement of discounts and of the time and manner of payment.

6. Rights of assignment or cancellation agreed upon. Circumstances under which instalments are to be treated as separate contracts.

7. Definition of any unusual or ambiguous terms and a waiver of rights due to misunderstanding of the terms of the contract. To illustrate, "immediate" shipment may be defined as within twenty-four hours of the receipt of the order, "prompt" as within three days, and "in a reasonable time" as within ten days.

8. An enumeration of the documents composing the contract. Statements made in designated letters or publications may be referred to as express warranties.

9. The description of any special method to be followed in settling disputes. No provision aiming to deprive either party of its final appeal to the courts should be introduced, for such clauses involve the attempt to oust the courts from their jurisdiction, and hence are null and void.

Specifications. — The quality of anything purchased may be determined, roughly, as an inference from the price. To trust to this uncertain relation is to buy on price. Again, the quality may be judged from the seller's reputation. To rely upon this is to buy upon reputation. The only way in which close buying can be done is to frame an exact conception of the thing wanted, on the basis of a knowledge of the action of materials in the process of manufactuer and of their effect upon the quality of the finished product. To make such exact knowledge control the buying process is to buy on specification. Specifications may originate with either the seller or the buyer.

The usual custom of the past has been for the seller to specify what he had; the growing practice of the present is for the buyer to set forth in detail what he wants.

Seller's specifications. — Seller's specifications are the descriptions found in catalogs and letters and advertisements, and in the communications of authorized agents. The law considers these to be a part of the contract of sale as express warranties, provided they have exerted a material influence as inducements with the buyer. It is particularly to be noticed, however, that no affirmation of mere opinion on the part of the seller, such as that he believes the goods will wear well, or that he expects their price to increase, constitutes a warranty. Some allowance is also made by the courts for mere puffery, or dealer's talk, such as that the goods are the best in the world, or that they are worth ten times the price. If a sample is offered by the seller under conditions which imply that it is intended to be representative, it partakes of the nature of a description, and creates the implied warranty that the bulk of the goods furnished will conform to the sample. If the seller is a manufacturer, and so presumbly possessed of an intimate knowledge of the nature of the sample offered, there is a further implied warranty that the goods furnished shall be merchantable, that is to say, passable as representative of the kind of merchandise which passes current under the given designation; and that they are free from such defects as are not discoverable by a reasonable examination of the sample. If, however, the buyer has ample opportunity and talent to discover the defects of the sample, and there is no fraud involved in the transaction, the rule of *caveat emptor* applies.

Buyer's specifications. — To avoid the uncertainties of interpretation and of legal liability involved in seller's samples and trade descriptions and advertising, the practice is growing among large concerns of buying materials and supplies on the basis of specifications prepared by themselves. These are drawn up by the purchasing department, working in conjunc-

tion with the testing laboratories and the shops, and are referred to in the order as forming a part of the contract. The seller is bound by the implied warranty that the goods supplied are of the kind described, or will answer the purposes indicated by the buyer.

A couple of examples will best convey an idea of the degree of precision which good practice now attains. The first description relates to foundry pig iron as bought by a western manufacturer of agricultural implements.

"Under these specifications we desire a good clean iron, as free as possible from dross, kish, oxide, sand, etc. . . .

"All grades of pig iron will be bought strictly by analysis, and must conform to the following specified per cents:

	Per cent
Silicon must not be less than	2.50
Sulphur must not exceed	0.03
Phosphorus must not exceed	0.60
Manganese must not exceed	0.50
Total carbon, not specified.	

"The carbons will usually be between 3 and 4.50 per cent, in this grade.

"Any car of No. 1 foundry pig which shows on analysis less than 2.40 per cent of silicon or more than 0.035 per cent of sulphur will be rejected.

"When a car of pig iron is received it will immediately be sampled by an experienced man (professional sampler), who will select a certain number of pigs from different parts of the car which, according to his judgment, shall represent the average quality of the iron. These pigs will be broken, and drillings taken from the face of the fracture will be sent to the laboratory for a chemical analysis. The analysis will decide the acceptance or rejection of the iron.

"Rejected cars will be held subject to the shipper's orders.

"In case of dispute the furnace or the seller shall have the

right to resample the iron in conjunction with the buyer, each to select five pigs. Drillings from the ten pigs, after being well mixed, will be divided into three different samples, one lot to be analyzed by the furnace, one by our laboratory, and one by a disinterested chemist, agreed upon by the parties in dispute. The two analyses nearest alike will be accepted as the proper chemical composition of the iron.

"In all chemical work relating to pig or cast iron it is understood that the standardized drillings furnished by the American Foundrymen's Association are to be used as standards."

These paragraphs in the original contract are followed by a statement of the chemical methods used in the laboratory, so that suppliers may anticipate results by making their analyses in the same manner as the buyer will make them upon delivery.

The second illustration reproduces the specifications of the United States Navy Department for toilet soap:

"To be milled, neutral, soda soap, made from clean, wholesome fat, and as free as possible from water, rosin, and mineral, starchy, or foreign material. Analysis must show not more than three-tenths of 1 per cent of mineral matter, three-tenths of 1 per cent of carbonated alkali, calculated as carbonate of soda (Na_2OO_3), one-half of a per cent uncombined alkali, calculated as caustic soda (NaOH), one per cent common salt, or 14 per cent of water. A cylinder of soap, seven-eighths of an inch in diameter and 1 inch high, cut from a cake, must sustain a weight of 15 pounds for five minutes without crushing or compressing more than one-sixteenth of an inch. Soap will be rejected if made so largely of cocoanut oil, palm oil, or other fat of characteristic smell that the peculiar odor remains on the hands after using. To be perfumed with the characteristic odor of lavender, perfume to add not more than 5 cents per pound to the cost of the soap.

"Cakes to be oval, to weigh about 4 ounces; color, light brown. Each cake to be wrapped in soft paper: to be packed in neat paper boxes, three cakes in a box.

"The soap will be bought by the pound.

"For inspection, one cake, taken at random, will be examined, and the lot will be accepted or rejected on this sample cake.

"The weight of the soap to be paid for will be determined by the amount of combined alkali or its equivalent in the lot; this to be found by multiplying the weight in grains of combined alkali in the sample cake by the number of cakes, then dividing this product by 630, the number of grains of combined alkali assumed as a standard pound of soap."

Specifications should embody a clear and concise description of what is wanted. If there is more than one possible meaning, the supplier must allow in his bid for the meaning most unfavorable to himself. The specifications should explain the manner in which samples will be drawn and laboratory tests conducted, should indicate what may be done in case of dispute, and should state what disposition will be made of rejected material. Unreasonable conditions should not be imposed, for unreasonableness operates as a legal defense for non-performance. No specification should be introduced which it is not intended to enforce, for every restriction narrows the market and, being taken into account by the seller in safeguarding himself, increases the cost.

When specifications are inapplicable. — Modern scientific specifications cannot be used: (*a*), where materials are wanted which pass through the hands of a produce exchange, such as the New York Cotton Exchange or the Chicago Board of Trade, on which grading is done exclusively according to the rules of the organization; (*b*), where unfabricated materials, such as wild rubber gathered by the natives of the Amazon valley, originate with a large number of small producers who are not under control; (*c*), where materials come from a distance, passing through the hands of many intermediary traders, as is the case with European manufactures generally, so that the buyer's requirements cannot be referred back from hand to

hand to the sources of supply; (*d*), where materials are controlled by a monopoly or are produced by a secret process.

The general effect of buying under scientific specifications is to raise the standards of both buyers and sellers. The buyer must live up to his specifications or lose by their use; the supplier must command sufficient knowledge to know whether or not his product will pass the buyer's tests. One of Andrew Carnegie's four rules for manufacturers is, "Subject all products to more rigid tests than purchasers require. A reputation for producing the best is a sure foundation upon which to build."

The size of the average order. — Some of the attractions which move purchasing agents to place large orders are, the insurance which an ample stock gives that factory operations will not be suspended by railroad strikes or other interruptions of supply; the economy of large orders in the matter of freight, cartage, and receiving expenses; a favorable aspect of the market which seems to recommend the accumulation of a stock in anticipation of future requirements, and quantity prices. Toward small and frequent orders the inducements are, a smaller investment in stock, less opportunity for physical deterioration and for obsolescence of class or design, decreased hazard of loading up at top prices or of entering dull seasons with heavy stocks, the possibility of securing quantity prices on the basis of annual patronage rather than of individual orders, and a more even distribution of bills payable.

Standardization. — The utmost advantage of buying on a large scale, consistent with light stocks and rapid turn-over, is only obtainable by standardizing consumption upon a few articles. An establishment without scientific purchasing is almost certain to show, in each class of stock, a variety of qualities, designs, and makes, representing the diverse opinions of different foremen and department heads, but intended to answer substantially the same purpose. The stream of stock

change flows slowly through a wide variety of types, just as a river flows slowly through a multitude of bayous: it is possible to place small orders, and yet have a store room choked with stock. To attain the opposite condition of heavy orders and a light stock, there must be concentration of demand upon a few things. The process of throwing out unnecessary variant types of stores must rest upon a thorough examination of shop requirements. It is likely to involve some remodelling of operations, possibly also some redesigning of finished products. When the best has at length been chosen, usage must be standardized, that is to say, individual cases must be made to conform to the rule.

Promptness. — A shop which is ready for a material is not satisfied with the assurance that it has been ordered. Results mean the materials at hand when wanted. Promptness is the chief means of preventing foremen from accumulating private reserves. Of supply departments which are slow and stingy Mr. H. C. Pierce has said, "Their idea was that by delay and obstruction some other arrangement would be made, and the material would not be needed at all. For that reason, departments that had work to do did not have confidence in getting what they wanted, and consequently laid in large stocks and made provision simply because they knew by experience they never could get anything when they wanted it. This led to enormous losses in the way of material deteriorating and becoming obsolete." [1]

The schedule of deliveries. — The larger the patronage controlled by a purchasing officer, and the more the supplying houses are impressed by the efficiency of the buying department, the more exacting it is possible for the buyer to be in the matter of the schedule of the time and place of deliveries. An accurate schedule, which brings in materials at the times when they are wanted for use, manifestly decreases the expense for stock, and stock-room operation. It is a matter of common

[1] H. C. Pierce, The Supply Department, N. Y., 1911, p. 110.

report that certain large automobile manufacturers in Detroit are able to specify not merely the day of shipment, but the day and hour of delivery at the plant, and the warehouse door at which materials must be presented.

Hedging. — The fluctuation of the prices of raw materials is a hazard for the purchasing officer and his employer which is unusually intense on the nervous and semi-isolated markets of the United States. In those lines of manufacturing where there is used a large amount of any material which is subject to organized and speculative trading, the fluctuations of the prices of raw materials may cause the profits of the business to depend in a large degree upon the skill of the buyer. The possibilities of loss and gain may be illustrated by tabulating the annual maximum and minimum prices of two or three basic commodities.

Middling Upland Spot Cotton on the N. Y. Cotton Exchange
(Cents per pound)

Year	Maximum	Minimum
1909–1910	19.75	12.40
1910–1911	16.15	11.60
1911–1912	13.40	9.20
1912–1913	13.40	10.75
1913–1914	14.50	12.30

Local No. 2 Foundry Pig Iron at Chicago
(Average monthly prices per ton of 2240 lbs.)

Year	Maximum	Minimum
1910	$19.00	$16.00
1911	15.50	14.00
1912	18.00	14.00
1913	17.90	14.60
1914	14.25	12.56

Number 2 Cash Wheat at Chicago
(Cents per bushel)

Year	Maximum	Minimum
1910	127.50	89.50
1911	101.00	83.25
1912	120.00	93.375
1913	115.40	84.00
1914	123.50	77.75

An experienced mill buyer of cotton has said: "As a general rule, it is more disastrous to buy at too high a price than to fail to buy at a low price, because if cotton advances, in normal conditions of the market, goods will advance in proportion, but if cotton declines after you have bought, the market for goods is apt to decline also, leaving you to take a loss on your high-priced cotton." [1] This is equivalent to saying that it is worse to make an actual loss than to miss a possible profit.

If, in the case of a fluctuating commodity, there is an organized market for future trading, the buyer may eliminate the greater part of his risk, and insure to his concern the normal profits of converting, by means of hedging transactions. The hedging operation will take one of two forms, according as it is to offset a long interest (the interest created by owning a commodity) or a short interest (the interest created by engaging to deliver a commodity, or its manufactured derivatives, without owning it). If a mill possesses a stock of raw material and has not contracted for the sale of the corresponding product, the appropriate hedging transaction will be to sell on the Exchange an equal amount of that material for delivery at approximately the date or dates when the stock or its product will be sold. If then, in the interval while thus protected, the price of the material falls there will be a loss on the stock held, but an equivalent gain on the future transaction, because the material required

[1] J. R. MacColl, The Business Side of Cotton Manufacturing, Trans. N. Eng. Cotton Mfrs. Asso., No. 77, Sept. 1904.

to fill it can be purchased at correspondingly less than the price which the contract calls for. If the price rises, the gain on stock will be offset by an equal loss on the future transaction. In case a mill contracts for the sale of its output in advance of the purchase of the necessary raw materials, the proper hedging transaction is to enter into future contracts upon the Exchange to receive the respective amount of basic material, at the period when it is expected to buy the actual supplies for manufacture. Future contracts are usually closed without actual receipt or delivery of commodities; and this is done by selling them just prior to maturity to brokers for ring settlement or mutual cancellation.

While dealings in futures offer considerable relief, they do not provide a perfect means of extinguishing risk, for the advances and declines of futures do not exactly correspond to the advances and declines of the spot prices of the same materials; still less perfectly do they correspond to the fluctuations of the manufactured derivatives of those materials.

Honesty. — Honesty must be a militant virtue with the purchasing officer. This is so because he has in his hands a patronage for which outsiders are in active competition, and because the results of private advantage can only be made apparent by cost accounting, a branch of accounting which is much less conclusive in its results than that employed for keeping track of cash. To delegate to another the power of purchasing supplies is to furnish money — the measurement of which is exact enough — but to hold for quality in commodities, the measurement of which has as yet been made exact only in the case of a few materials. The problem of answerability in that form of delegated authority where the quality scale covers the value scale from direct access is an ancient one. Kipling says,

> "Who shall doubt the secret hid
> Under Cheop's pyramid
> Is that the contractor did

Cheops out of several millions;
Or that Joseph's sudden rise
To Controller of Supplies
Was a fraud of monstrous size
On King Pharaoh's swart civilians."

The risk entitles the purchasing officer to every moral safeguard his employer can throw around him. To leave him without the checks of an efficient system of supervision is not so much to trust him as to abandon him in a moral contest. Some precautionary measures are as follows:

1. The first step is to select a man of sound training and good general ideas as to the methods and objects of life, and one possessed of sufficient moral courage to hold facts persistently in mind when they are personally disagreeable. It is well if such a man has formed the habit of making sharp and final decisions with reasonable promptness.

2. The second safeguard is to dignify the man and his function. The conception that we find others entertaining of us and of our work is a mighty force in developing a corresponding dignity of character within us.

3. A special case of this policy is to concentrate buying in the hands of one or more of the proprietors or high officers. Such persons, it may be argued, will have so great interests at stake on the side of efficiency that small speculations will have no attractions. Furthermore, the position of the buyer will exercise an influence to restrain overanxious or dishonest agents from making improper advances. When, however, graft develops in high places it is difficult to uncover, for subordinates who may know what is going on will feel that to reveal the truth is equivalent to asking for a discharge.

4. The idea should be definitely established in the purchasing department that any gifts or attentions which have as their effect to cause an officer to feel a sense of obligation to suppliers or their friends are improper, whether the person

bestowing them had in mind such an influence or not. A judgment which is hampered in the execution of a trusteeship by a sense of friendly obligation is not in normal poise. The first steps toward corrupting a buyer may be small and indirect: mere signs of convivial disposition or of a real personal liking. The danger of these steps lies in the fact that they lead a little distance along a scale of compromises the gradations of which are so infinitesimal, from step to step, that, once entered upon, it is difficult to find a point at which a decided stand may be taken, without appearing to be unreasonable or unfriendly.

5. A fundamental policy in dealing with any derelictions which are a part of a cumulative series is early and thoroughgoing remedial action. Dishonest acts undoubtedly tend to become part of a cumulative series, for if undetected and unpunished, they appear to justify themselves. The doer gains confidence in his skill, while he loses skill in other means of self-advancement. He revolts less at what becomes increasingly familiar. And the gains serve to finance habits of life which are physically agreeable and involve a social commitment.

6. The buying department should be entirely separate from the manufacturing departments. There will thus be created a system of checks and balances. Officers in charge of manufacturing and selling who are made to feel that the records of their departments are not satisfactory, and who know that the cause is poor material, are likely to defend themselves by putting the blame where it belongs. For a similar reason buying may be separated from receiving, testing, and inspecting. The more independent officials there are engaged in the different phases of a matter, the more publicity there will be, and the less likelihood there will be of collusion.

7. For certain classes of buying the rule may be established that bids must be secured from two or more parties, and the order placed with the lowest bidder, except where the consent of

designated superior officers is secured. The documents of the bidding should then be treated as permanent records; while audits and tabulations of bids and purchases can be made from time to time for the information of supervising officers.

8. A powerful deterrent to fraud is the compilation of the performance of materials, both in the shops and in the hands of consumers, to show the record both by batches and by firms of origin. If high waste percentages and large rejections in manufacture or frequent returns by customers characterize the materials furnished by certain supplying concerns, the persistent patronage of those concerns will require explanation.

9. It is a help in preventing the offer of secret commissions by selling agents, if there is in existence a law like that of New York State, making proof of the offer of a bribe operate to discharge the indebtedness due for the merchandise purchased in connection with the bribe.

The Stores Department

The need. — In establishments where any considerable variety of materials is used, if a stores [1] department is not provided there exists a condition of individual self-help. The foremen, ignorant of the exact amounts of material required for jobs, order excess quantities, to be on the safe side. Every foreman or department head who remembers previous delays, or who looks ahead to protect his men from lay-off in a dull time, will try to accumulate a secret reserve, and run a little warehouse of his own in some corner. Such a system of private stores will involve much duplication, for the sum of the reserves of any one material in a series of separate lots will be more than would be needed if the lots were pooled. The individual requirements are not permitted to average themselves out in a more uniform and predictable rate of aggregate use.

[1] It is convenient to use the word "stores" to designate raw materials and supplies, while the word "stock" is applied to parts and finished articles.

Unsystematized supplies mean capital not earning interest, but subject to physical deterioration and obsolescence. Mr. F. A. Parkhurst recalls one case, "Where a 10 ton lot of large rivets was discovered while operations were under way to inventory and centralize all stock. These rivets were in the original kegs which had never been opened, and were buried under hundreds of empty kegs and boxes in an old shed supposed to contain nothing but old packages. They had been overlooked and had lain for a year or two while new lots were being bought periodically. In another case a thousand pounds of copper was found lying back of an old shed; and still another example of the need of a stores record was the finding of certain machine parts worth thousands of dollars. These parts were more or less standard and were continually being used, but had accumulated in odd lots and at odd times and some of them particularly were found in odd places, while apparently no one knew they were in existence. After they were duly recorded and placed in stock, it took nearly three years to dispose of them."[1] He adds, "A dollar saved either in material or labor, or both, is a dollar profit — all profit — worth six to ten times a like amount of new business."

In spite of excess material, an unsystematic condition will involve much delay in waiting for required things, for no comprehensive agency exists to see that the assortment is complete. A need in one department is not met by an unknown supply in another. Energetic department heads will prefer to order new material rather than hunt outside of their department, or will take materials too good for the job in the absence of the things which economy would dictate.

If inadequate handling of raw stores causes unbalanced supplies and the expenditure of labor without corresponding product, the inadequate control of finished stocks leads in like manner to the production of goods not needed. The foreman

[1] F. A. Parkhurst. Applied Methods of Scientific Management. N. Y., 1912, pp. 90–91.

who secretes a reserve of stores to protect his men from lay-off turns out finished products without authorization, and throws the stock out of balance. The absence of a stores system hides spoiled work, for the workman can get a new piece of material to take the place of the spoiled one without creating a record.

Functions. — A stores system, for a manufacturing establishment, is such an orderly administration of the values locked up in materials during the making process, as the stock system of a wholesale or retail store is for corresponding values during the distributive process. The system which comprises requisitions, shop orders, store room, and a continuous invoice is for materials an analogy with the system composed of the bill, the receipt, the safe, and the cash account used for handling money. Raw materials and manufactured stocks are more liable to waste and theft than land, buildings, and fixtures, because they are movables. They are more in danger than movable equipment not only because adapted to more uses, but because the replacement of equipment is an exceptional act which calls attention to the cause, while materials are a current asset, the constant arrival and departure of which hides losses. If materials are in less danger of theft than money, because less concentrated in value, less universal in appeal, and less easily exchanged, they are, on the other hand, more liable to incomplete delivery, to physical deterioration, to waste in the converting process, and to obsolesence. The analogy with money is closer than it is with buildings and equipment; the system employed for administration should reflect this similarity.

Definite and concentrated location. — Administration is, in a sense, a function of space: distance wears down energy, and distribution taxes memory. The finer the control aimed at, the more definite and concentrated in their location should be the agencies controlled. Concentrated location of materials permits special equipment, gives easy receipt and issue, lowers warehouse expense, and permits more efficient guarding. Raw

materials will naturally be located next to the initial stages of manufacture, while finished stock will be carried next to the shipping department. The location of sub-stores is a question of trucking economics.

Classification. — The accessibility of the units of any collection depends chiefly upon classification. The basis of classification should be the dominant logical relationship into which the parts fall in the establishment. In a manufactory whose product is a composite of parts, the dominant logical relationship is usually the relation of the parts in the unit of finished product. The classification should be composed of distinctions which are sharp and definite, leaving no vague middle ground. A distinction must be applicable to every unit in the class which the distinction aims to subdivide. The class and sub-class designations must be the only names permitted for the articles. And, finally, the classification introduced into stores, stocks, accounts, and operations should be coördinate; that is, one dominant scheme of analysis should govern throughout.

Mnemonic system. — The pioneer establishment to systematize the classification of a large number of different articles was the public library. From that source stores departments have borrowed the idea of an arbitrary classificatory scheme or mnemonic system. It is a great convenience to have a system of conventional or arbitrary signs which, because of their arbitrariness, can be given an exact meaning entirely free from any customary or popular significance, and by which any article may be absolutely identified with the utmost brevity, while yet, through the composition of the symbol itself, all desired matters with reference to class and sub-class are indicated. The ideal system should be built up from a small number of basic symbols — usually letters and figures — each step in the combination being left open so that new classes of articles can be provided with designations without altering the system or disturbing the designation of articles already in use. Systems

of classification based upon correct principles have been introduced into industrial establishments in connection with scientific management. While mnemonic symbols may strike an outsider as cryptic, it is vastly easier for those who use them to learn the few elementary symbols, and the simple system of combining them, than to struggle with the perpetual misunderstandings inevitable with the use of general descriptive phrases or rapidly shifting trade terms.

A system of requisitions. — All disbursements of stores or stock should be upon the authority of written requisitions. When the requisitions which have been honored are classified according to classes of stock, and to this record is coupled a similarly classified account of the last invoice, and of all purchases made since the invoice was taken, it is possible to maintain a continuous invoice, telling how much of each article is on hand, and the value of such remainders.[1] The classification of requisitions according to job numbers will make it certain that all material used has been charged, either to its job, or to the proper class of expense.

Standard purchasing schedule. — From the records of requisitions there can be ascertained the rate of use or outflow of each kind of stores. As the inflow or purchasing is intermittent, there can be established, on the basis of a given size of order, a schedule of the required frequency of purchases. The purchasing schedule will be adjusted between the necessity of maintaining the minimum stock sufficient to meet requirements, and the desirability of ordering in commercial quantities. The purchasing schedule can be made to operate automatically on the prompting of the stores department if for each class of stores there is fixed the maximum and minimum amounts to be

[1] Stores accounts may be arranged on the following formula: (Amount received) − (Amount issued) = Amount on hand; or they may be arranged to show for each class: (Raw materials + stock in process + finished stock) − (Amount required to meet promised deliveries and sales orders) = Balance.

carried. When the minimum is reached the stores department notifies the purchasing officer, who in turn places an order of such size that when the incoming amount is added to the balance on hand, the total will not exceed the maximum limit.

The schedule of shop orders. — Just as a requisition system for stores permits the working out of a rational schedule of purchases, to the end that the schedule of manufacturing operations in the shop may be free from disturbance caused by the delay of materials, so a record of shipments of finished products from stock, together with an estimate of quantities required to fill orders on hand, when brought into relation with a statement of stock on hand and the requisitions of parts for assembly, permits the arrangement of an advance schedule of jobs in the manufacturing departments, which can be carried through free from the interruptions of rush orders. Economy demands that work be put through the shops in adequate lots, and that jobs be allowed to follow one another in orderly succession, so that the various departments can be kept full of work under even pressure. Mr. F. A. Parkhurst says, "Where but twenty pieces of a kind are used in a year, it is obviously cheaper to make them in lots of eight or ten for stock at a reduction in cost and carry them through a period of two to six months than to rush even one through, perhaps having the work done expensively by an inferior man, and usually breaking up the time of some other job. In many cases the labor cost on parts can be reduced 80 per cent by the change in methods even when dealing with small quantities of eight or ten pieces. Even such small lots give satisfactory results when methods, tools, time studies, and determination of bonus are carefully planned, showing an immense saving in cost to the firm, to say nothing of the delay which is avoided. The interest on the value of the stock tied up for two or four months is practically negligible when considering the other savings mentioned." [1]

Elasticity, or allowance for change of program, is required at

[1] Applied Principles of Scientific Management, pp. 94–95.

some point in every chain of functions. If the manufacturing departments are, at one time, being held up for lack of supplies, and at another time are thown into confusion by a rush order, which side-tracks the regular work, it is obvious that these departments are being used as the elastic member to take up the slack and tension between the incoming stores and the outgoing stocks. This is a costly error. The very idea of a stock or store is a reserve for contingencies. The schedule of manufacturing operations should be protected from the shock of the irregularities of external business relations by adequate buffers of stock at the entrance and exit ends. At the raw-material end, stores serve to even out the irregularities of supplier's deliveries: at the finished-product end, stocks meet the fluctuations of consumers' demand. Protected by these two reserves, the schedule of manufacturing operations is permitted to attain the efficiency of continuous operation and mass production.

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CHAPTER XVII

SELLING

We speak of a merchant as a middleman. Certainly, if it is a man's business to be a middleman, he should know the condition of the men on either side of him, between whom he is attempting to serve as a connecting link. A sales department is a middle department standing between the producing shops on the one side, and trade buyers and consumers on the other. The basic rule of efficiency in selling is to know thoroughly the properties of goods and the needs of people. The reason why this rule is not universally accepted is that it is possible to make a brief record which appears like success by cutting prices, or by applying the arts of salesmanship and advertising to goods without distinctive merit of design or the attraction of low price. Misfit sales do not maintain themselves, however, for each of such sales installs in the possession of the buyer an article which begins at once to educate him as to the error he made in acquiring it, and which re-emphasizes the point steadily and concretely as long as it exists. Intelligently directed sales campaigns aim, therefore, at selling service or satisfaction, by which alone permanent trade connections can be formed. A single sale is a touch-and-go economic relation; and is exceedingly liable to abuse. The bane of the selling world is that there are so many persons in it whose interest, and therefore whose analysis, reaches only a little way into the future. It means nothing to such opportunists to say that the merchant must make fundamental studies of the world of wants and of the world of goods, and

must govern himself by principles which work out in the long run, if he would be a master of his art, and would establish any great and lasting enterprise as an intermediary between the two.

The functions. — The functions of a selling department may be specified somewhat more in detail as follows: With reference to the contract of sale, it will be necessary to determine what warranties shall be given, when title is to pass, and what tolerance as to quantity, quality, or time of delivery is to be specified. An office plan will be needed for handling the various documents connected with sales. There will be the question of fixing standard prices, bulk prices, and differential prices; and the defining of the terms of delivery and of payment. The selling department should have much to say about the merchandise which the shops make, especially as to finish and the style of packaging. It will control such active agencies of sale as travelling salesmen, branch agencies, retail stores, and the advertising campaign. In its relation to dealers it will form a policy upon such questions as who shall be eligible to purchase on given terms, whether exclusive territory shall be granted, whether efforts shall be made to control the price of resale, what attitude is to be taken toward cancellation of orders and the unjustifiable return of goods, and what education and stimulus shall be provided for dealers.

Administrative relationships. — Manufacturing and selling are two entirely different businesses. The sales manager should be coördinate with the works manager, and under the supervision of the general manager. Close contact between the selling and making ends of a business should be maintained, in order that defects in the product, revealed by customer's correspondence, or reported by dealers to the salesmen, may be transmitted to those who are responsible for quality and design. The selling department should be informed of the qualities of raw material used, the processes employed, and any features of design which are considered unique, to the end that the sales-

men may be trained to detect the exact conditions under which the company's product will give satisfaction, and that the advertising can be written with freshness and convincing point.

Contract of sale.[1] — An explicit memorandum of sale is important to the seller as a means of reducing cancellations, disputes at settlement, and bad debts. To the buyer it is important when claims are to be made. If merchandise remains in the possession of the seller after title has passed, a written memorandum is useful in proving title as against creditors or subsequent *bona fide* purchasers.

Some of the problems which arise in drawing up standard sales contracts may be suggested by reproducing clauses from some uniform sales contracts, which have been employed with success in certain lines of trade.

Contingencies: "This contract subject to conditions over which the seller has no control; such as strikes, lockouts, boycotts, fire and flood, and restraining acts of the State in connection with public health or war."

Delayed shipment: "The seller, under the terms of this contract, shall have no less than fourteen (14) days from receipt of shipping instructions, to satisfy same and make shipments. Failure on the part of the seller to complete shipments within primary contract time, or within fourteen (14) days from receipt of shipping instructions (unless prevented by conditions beyond his control) shall entitle the buyer (*a*) to cancel such specified portion, and collect from the seller the difference in value of such portion between date of purchase and date of cancellation, or (*b*) to continue the life of said contract at credit of five (5) cents per barrel for flour, and twenty-five (25) cents per ton for feed for each thirty (30) days' period or fractional part thereof, beyond the limit of primary contract shipment, or said fourteen (14) day period; it being agreed

[1] Compare Chapter XVII, Purchasing and Stores Departments, pp. 345–346.

that unless notice to the contrary is served on seller, clause (*b*) of this paragraph will govern."

Millers' National Federation.

Delayed shipment instructions: "Unless otherwise specified, time of shipment is to be within sixty (60) days from date of contract. Goods not ordered out within sixty (60) days from date of contract, or within contract shipment period, are, without notice to buyer, subject to the following carrying charges:

"Flour: Five (5) cents per barrel for every thirty (30) days, or fractional part thereof.

"Feed: Twenty-five (25) cents per ton for every thirty (30) days, or fractional part thereof.

"Such carrying charges become due and payable at the beginning of each thirty (30) days' period after the termination of the time of contract shipment, the buyer hereby agreeing to pay the same. The life of this contract, however, shall in no case be thereby extended for more than sixty (60) days.

"Failure on part of the buyer to order out purchase before expiration of extended contract period gives the seller the right to cancel the contract, or unshipped portion of the same, and to collect from buyer, on unshipped portion, the difference between market value of the same at date of sale and date of termination, with all accrued carrying and all selling charges."

Millers' National Federation.

Allowable variations: "If the production of the seller shall be curtailed during the time above named, by strikes, lockouts, or unavoidable casualties, the deliveries shall be made and accepted in proportion to the production."

Nat'l Asso. of Cotton Mfrs., and
Am. Cotton Mfrs. Asso.[1]

"Shipments which vary within 5 per cent of the amount specified in this contract shall be accepted in discharge of the same, and be paid for pro rata."

[1] This contract also contains detailed provisions as to allowable variations of width, warp count, filling count, and weight.

Separable instalments: "When contract calls for delivery in instalments, the buyer cannot cancel the contract for any default in any one or more instalments not amounting to a substantial breach of contract, but may cancel or replace at seller's expense any delivery that is delayed."

Nat'l Asso. of Cotton Mfrs., and
Am. Cotton Mfrs. Asso.

Passage of the title: "Unless otherwise specified, the title to goods sold passes to the buyer (subject to the right of stoppage *in transitu*):

(*a*) "Upon delivery F.O.B. to carrier, consigned to buyer, and thereafter goods are at buyer's risk.
(*b*) "Upon arrival of goods at destination and delivery to buyer of bill of lading or of goods, in the case of goods to be delivered F.O.B. elsewhere than to carrier.
(*c*) "Upon delivery of endorsed bill of lading or of goods, in case of goods consigned to seller's order.
(*d*) "Upon the separation of the goods and holding subject to buyer's order (the invoice to follow by due course of mail), in the case of goods to be held or if buyer fails to give shipping instructions."

Nat'l Asso. of Cotton Mfrs., and
Am. Cotton Mfrs. Asso.

Price and quantity. — The adjustment of the price to the quantity involved in the order raises the important question whether the principle of giving quantity prices is to be followed, that is to say, whether or not lower prices will be given for large orders. Large dealers favor quantity prices. Small ones favor prices fixed on the basis of the class or status of the dealer, and so made to apply equally to all in the class — as to all jobbers or all retailers — regardless of the size of the order.

A minor question has to do with package differentials. The disregard of this adjustment sometimes gives to market quo-

tations a degree of indefiniteness. The differential scale of the Millers' National Federation is as follows:

Bulk	20 cents per bbl. less than basis
Paper	10 " " " " " "
140 lb. jute	10 " " " " " "

Cotton sacks, 96 lbs., 48 lbs., and 24 lbs., Basis

$\frac{1}{16}$ bbl. cotton	15 cents per bbl. over basis
Wood	15 " " " " "
$\frac{1}{2}$ bbl. wood	45 " " " " "

Price and classified lists. — To whom shall sales be made? To dealers only? There are many classes of dealers. Goods flow up hill in price, moving from one dealer to another, in response to the attraction of a prospective trading profit. Broadly speaking, there are three price levels: manufacturer's, wholesaler's, and retailer's. If sales are made without establishing differentials to safeguard customary profits, the economic impulse is destroyed for all the dealers who are primary to the one supplied. Such goods will cease to move normally, unless they are so strongly intrenched in public favor that they must be handled by dealers as an accommodation, to complete trade assortments.

To apply differential prices accurately is a difficult matter, and calls for the careful compilation of classified lists of dealers, so that each dealer will be quoted only those terms which are appropriate for his class. Let us say that it is decided to sell to wholesalers at given prices. What constitutes a wholesaler? Is a department store which prints on its letter head "Wholesale and Retail," but develops no wholesale business outside of that which comes voluntarily as local accommodation, a wholesale house? Is a southern retailer, who in ante-bellum times got wholesale terms, entitled to those terms now? If manufacturers are to be given wholesale terms, is a bicycle repair shop to be considered a manufacturer, when much larger sales

are made at retail to the hardware store around the corner? If hotels are to be given wholesale terms, is a restaurant a hotel; and what shall be done with the boarding-house trade? Shall goods be sold on the same basis to dealers who handle them as side lines as to those for whom they constitute a main line? The point of this is that side lines are often handled at less profit than is required of the main lines, so that the use of a firm's goods as side lines may injure the distribution through the main channel.

Guarantee of prices. — In businesses of a seasonal nature it is a great advantage to a manufacturer if he can induce his customers to place orders considerably in advance of the time when the goods will be wanted. To the buyer the placing of such advance orders means the assumption of the risk that prices will decline after the goods are bought, but before they have come into his possession. To protect customers against this contingency, manufacturers are sometimes asked to guarantee prices. This means to agree to accept the price which is current on the delivery date. A difficulty inherent in all such agreements is that no ready means is at hand for determining what constitutes the current price. Does a single low offer, made perhaps by a rival from motives of revenge, establish a current price? In some cases the quotations of a produce exchange, or of some price board, can be utilized, as a basis to which an agreed converting profit is to be added. The guarantee of prices by a manufacturer to a dealer, especially to a jobber or to the buyer of a large department store or mail-order house, is a violation of the principle of the division of labor, for it sets one who is primarily engaged with machinery and the processes of manufacture at the task of calculating the changes of supply and demand for one who is a student of prices and a market expert. It would seem that the more correct solution of the problem of seasonal manufacture is to take advance orders at lower prices, as is often done by discounting at an attractive rate for prepayment.

Control of the prices of resale. — In recent years retail competition has often taken the form of selling nationally advertised articles as leaders at reduced prices. Such use makes the articles unprofitable to dealers, and operates to cause them to be dropped. Manufacturers have, therefore, been aroused to protect their products by controlling the prices at which the dealers sell. State statutes and state court decisions run in contrary directions with reference to the legality of such attempts. The United States Supreme Court has declared null and void all efforts to encumber a chattel with price restrictions, in interstate trade, after such a chattel has passed into the hands of independent dealers. A manufacturer can, of course, control the prices charged by dealers who are his *bona fide* agents, acting under the law of principal and agent in their relations with him, and not under that of contract of sale.

Agencies. — In certain lines of staple product a manufacturer can distribute through commission merchants, or through controlled but separately incorporated sales agencies, and in so doing reduce his selling functions to a minimum. The relations of the parties under such a system will be governed by the terms of a comprehensive agency contract of several years' duration. The adjustments required between the manufacturer and his distributors will be chiefly of an accounting and auditing nature; except that some sort of a campaign of publicity may be carried on to make the establishment known to the public, and to prevent the maker from becoming helpless in the hands of his distributors. If the marketing is done through controlled agencies, it will be found convenient to have them separately incorporated, not only because special charter powers, not possessed by the manufacturing corporation, may be needed, and because state license fees and taxes are thereby lessened, but also because the control of existing distributive businesses is more easily acquired if a capital interest can be retained by the former owners, while good-will is best conserved by leaving the existing firm names undisturbed.

Travelling salesmen. — The system of selling through travelling salesmen was developed in this country after the Civil War, when the problem of marketing the products of the new American factories which had sprung up during the war, and in response to a high tariff, had become acute; and when the old importing houses and commission agents could no longer maintain their autocratic attitude of expecting customers to come to them. The first men chosen as travelling representatives were ignorant of merchandise and of the needs of dealers and consumers; they trusted to the prestige of expansive manners and loud dress, and to the ingratiating influence of cigars and drinks. They were found to be expensive and inefficient. Their places were gradually taken by quiet men who aimed to deserve the confidence of buyers by knowledge, good judgment, and character. The deathblow was given to the earlier type of salesman by the ridicule contained in Lorimer's "Letters from a Self-Made Merchant to His Son." [1]

The inefficiencies of salesmen (apart from native talent) spring from the attempt to sell things as different from what they are, owing to ignorance of commodities; second, from the attempt to sell people things they do not need, either because of ignorance of the customer's circumstances, or from the deliberate purpose of overloading the customer; and, third, from lack of conviction and courage, caused by an imaginary conception that rival goods are better than the ones offered — an impression which is often founded on ignorance of other goods. Mr. James Hartness, one of the foremost designers of the American machine-tool trade, has pointed out that dissatisfaction with a well-seasoned design is, in large part, due to an imaginary conception of the superiority of rival designs; a superiority which disappears on intimate acquaintance.[2]

[1] Geo. H. Lorimer, Letters from a Self-made Merchant to His Son, Boston, 1902.

[2] Human Factor in Works Management, N. Y., 1912, pp. 138, 144, 149.

Administration. — The old method of recruiting a sales force was to assume that salesmen were born and not made, and to try by perpetual hiring and firing to select the geniuses. The new method is to use much greater care in selection, but supplement natural talent by systematic training. The old method of supervision was to divide the territory, pay satisfactory salaries, and leave the men to work out their own salvation. The new system is to control the order in which the men travel their routes, fix the prices and terms to be offered, pave the way for calls upon customers by literature sent in advance, keep in almost daily stimulating touch with the men, and make them feel that their records are constantly watched, and that they will be advanced in proportion to their ability to earn profits.

Assignment of territory. — In the assignment of territory to salesmen the principal considerations are: (1) to cover the entire area within which there is relative competitive advantage; (2) to organize the territory of each salesman as compactly as possible, to save time and travelling expense; (3) to make the routes of the different men as nearly equal in trade possibilities as may be, so that a comparison of individual sales will serve as an index of efficiency; (4) to make each route of such size that a salesman must thoroughly canvass the trade to make satisfactory total sales, that the salesman can get around to each point on his circuit as frequently as is deemed necessary, and that the total sales shall be sufficient to keep the salesman's salary and expenses within a certain percentage of the net sales or gross profits. Manufacturer's salesmen may be contented with two trips a year, with extras between as conditions require; the representatives of wholesalers visit their towns at least once each month, while, in the parts of the country where the competition is active, an interval of more than two weeks between calls is considered unsafe. (5) The utmost advantage should be taken of the personal characteristics and experience of salesmen, and of the

acquaintance they may have with the dealers of a given territory.

The area covered by a manufacturer's salesman may vary from a great city or a single state to five or six states. A wholesaler's representative may have a region containing from 20 to 40 good-sized towns which are to be visited on each round, together with a number of smaller places to be visited occasionally.

Revision of territory. — If a body of salesmen be left to themselves for some time in travelling their territory, it will be found that many localities cease to be visited, and that many merchants in places visited are no longer called upon. There are various reasons to account for this. A salesman will usually develop only such trade in a territory as he thinks he can take care of. He will prefer to skim the cream of a large region, by making the more convenient towns, and by calling upon the larger or more friendly dealers, than to work a smaller territory more intensively.

Mr. Masters has explained the process of deterioration which goes on in salesmen's work as follows: "The older houses who retain their men for long periods have at times a serious condition of affairs confronting them. They find their territory narrowing, and when they lose a customer in any given field or city it is difficult for their salesmen to make satisfactory arrangements with another firm. The old salesman has grown into a groove, contenting himself with visiting his regular trade and neglecting to keep in touch with other concerns, until he is at a disadvantage when any change occurs in his territory. Then, it is impossible for a salesman to please every one. He meets with discourtesy from an occasional boorish buyer, or shows some disagreeable traits himself and a coolness results which leads the salesman to pass by that particular house. The stress of competition between his customer and the other firms of the town may oblige him to confine his attention to one firm until by long association he becomes locally identified with his customer and he is *persona non grata* with the other dealers.

A desire to cover his route quickly, or a settled routine which has by time been converted into a habit, leads him into a beaten path from which he never strays, and the increased opportunities for an extended trade mean nothing to him." [1]

To correct such a condition, a series of "rider routes" may be superimposed upon the older routes, including only the towns and the merchants not visited by the older salesman; or the routes may be somewhat shifted to create new territory between them. The rearrangement of salesman's territory, after things have drifted for many years, is both disagreeable and dangerous. It is much better to avoid the necessity for it by establishing a competent system of control, and keeping conditions up to the mark from the first.

Routing control. — A sales manager should organize a system by means of which he knows approximately where his salesmen are at all times. To do this the localities at which visits are to be made by the salesmen must be determined by the house, the order in which these localities are to be visited must be fixed, and the date of the visits must be set within a day or two. A salesman, when on the road, must then keep his chief informed of his location, by a daily report, and must state where he is to be for the next few days.

One of the devices for handling a routing system in the main office is called the map and tack method. It originated in military administration. Colonel Vachée [2] thus describes Napoleon's methods: "On campaign, on the eve of battle, night was specially devoted to his intellectual work. Having generally retired to rest about eight o'clock, after dinner, he rose at the moment the reports on the reconnaissances reached imperial headquarters, that is, about one or two in the morning. Becler d'Albe had spread out for him on a large table, in the room which served as a study, the best map of the seat of the war. On this map, set very accurately to the compass, and

[1] The Iron Age, June 4, 1903.

[2] Napoleon at Work, London, 1914, p. 10.

surrounded by twenty or thirty candles, were marked with pins with coloured heads the various positions of the army corps and, as fast as they were known, those of the enemy. It was on this that he worked, moving his compasses, open to the scale of six to seven leagues — a march — here and there. Before the night was over he had made up his mind, and dictated and despatched his orders, which the troops carried out at break of day."

As the modern captain of sales uses this device in the control of the marches of his salesmen, the map and tack outfit consists of a series of maps, mounted upon the soft wood bottoms of shallow drawers, and assembled in a case. The tacks are covered with different colored cloths, each salesman having a color. The territory assigned to a salesman is then marked out on the map, and the towns to be visited are designated by colored tacks, and connected with a thread of the same color, to show in what order they are reached. The location of the salesman at any time is represented by a large, flat-topped, paper-covered tack upon which the salesman's name is written. As he moves from place to place, the name tack is moved to the corresponding positions. Tacks of various shapes and colors, or bearing upon their heads various words or symbols, may be used to designate towns in which new customers are to be called upon, or in which collections are to be made, or in which grievances are to be adjusted. Whenever any of these matters arise a tack of the proper sort is placed at the appropriate town, and left there until the approach of the name tack on the route gives warning that it is time to send the salesman special instructions. The map and tack system brings out very clearly such matters as the towns visited and those not visited, the location of the salesman at any time, the next mailing point, and the towns in which the salesman is to be asked to do some special duty. It reveals in graphic form whether the routes are compact or not, and whether or not the towns are taken in the most convenient order.

Records and reports. — As a supplement to the equipment above described, the sales manager should maintain in his office a system of card catalogs giving information about cities and customers. The arrangement of cards should be by states, by cities alphabetically arranged under states, and by firms alphabetically arranged under cities. Separate town and customer cards should be provided. The town cards should show name, state, county, population, railways, freight rates, shipping instructions, express companies, banks, collection attorney, remarks as to any special characteristics of the place as a market, and the name of the salesman covering the locality. Customers' cards should include, among other things, the customer's firm name and address, the various lines of goods carried, the lines bought of the house, credit rating, credit limit, advertising matter sent, the salesman concerned, and a record of purchases by months for several years back.

If the office records are to possess value they must be kept revised strictly to date. Voluminous reporting is a provoking tax upon the salesman's time and energy. The facts asked for should be cut down to essentials, so that a strict policy of insisting upon them will be accepted as reasonable. It is chiefly through the reports of his travelling representatives that the sales manager can keep pace with the development of his territory, can learn what lines are unprofitable and why, and can ascertain what territory belongs normally to another supplying centre. From such reports, also, the credit man can get early warning of conditions which will make desirable the curtailing of a credit or the closing of an account. Prepared report blanks are superior to letters; they save writing, and yet prevent the omission of anything essential, by providing a separate space for each class of facts. If a sales manager desires his salesmen to enter heartily into the performance of other duties than straight selling, he must devise a system of remuneration which makes excellence in those other duties count in determining the wages and in the final rating of the individual

as to efficiency. In other words, the rating must not be based on net sales alone, but must be a composite or "point" system, in which each kind of work required is given its relative weight.

If it is important that the salesman should keep the house informed, it is equally essential that the sales manager should keep his salesmen posted. There are two matters which always require the latest possible data, namely, prices and credit conditions. Under the routing system, the home office always knows where to address mail or telegrams to the salesmen. Credit information concerning every customer in each place to be visited before the salesman again receives mail should be compiled upon town credit cards and mailed to him as late as can safely be done to reach destination in time. On these cards each customer's account should be entered up to date, the remaining credit allowance being shown, and instructions with reference to selling or collecting being embodied in the sheet, in secret symbols, on the authority of the credit man.

Coöperation with the salesman. — The distant sales representative of a house meets all the criticisms and uncomplimentary comparisons of his house, which the defects in its methods produce, or which competition engenders; and he meets them alone. He needs support from those who are stronger than he, or who are not so severely tried, or who have the advantage of working in close association with each other.

The salesman's remuneration should be adjusted to performance, either through the use of a commission added to salary, or by a system of frequent promotions which gives prompt recognition to increased earning power.

The salesmen should be furnished with frequent, clear, and emphatic proofs of the fairness of the prices asked, of the soundness of the merchandise offered, and of the integrity of the business policy of the firm. The aim of these things is to produce an unshakable conviction in the salesman's mind that he does not fear competition, and that he is conferring a benefit upon his customers quite as much as receiving one at their

hands. Through a constant, tactful, friendly, and invigorating correspondence, there should be made vivid in the traveller's mind the spiritual presence of those with whom he is associated in interest.

By prizes, bonuses, honorable mention, and otherwise, emulation may be given interesting and varied aspects, and can be broken up into "heats" which relieve tedium, and be made to end in attractive climaxes which socialize the effort and add to the other rewards that one which is dearest to the sensitive nature, namely recognition. Care should be taken, in making all personal comparisons, not to create the impression that the force of salesmen is definitely and irrevocably sifted into the classes of good, bad, and indifferent. Definitive classification is the death of emulation. It discourages those at the bottom; it makes those at the top too well satisfied with themselves.

One of the greatest salesmen [1] in America has said, "The best way I know of keeping a selling organization up to the highest mark of efficiency is to get all of the men together once a year in a confidential convention, for a heart-to-heart talk." By means of a convention, the salesmen become acquainted with the officers of the company, and with each other; they have an opportunity to study the merchandise carried by the house, article by article; they exchange experiences with each other which reveal the real nature of difficulties misconceived, and the real superiority of the best methods; and they develop an *esprit de corps* which warms their work with a touch of sentiment.

Miscellaneous methods of distribution. — It will be the function of the selling department to devise and administer any unusual or temporary selling methods which may be required, such as a mail-order system for introducing goods until sufficient trade can be generated to attract the attention of dealers; a chain store method, if merchandise is of a character

[1] Mr. Charles Miller, Pres. of the Galena Signal Oil Company.

to stand by itself as a separate stock; a bid and contract system for dealing with equipment orders, or for supplying the Federal, State, or local governments; and an auction or lump sum method for clearing out seconds, mill ends, or merchandise of obsolete pattern.

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CHAPTER XIX

ADVERTISING

Advertising is a sort of machine-made, mass-production method of selling, which supplements the voice and personality of the individual salesman, much as in manufacturing the machine supplements the hand of the craftsman. The cost of bringing an appeal to an individual by advertising has been estimated at from $\frac{1}{100}$ to $\frac{1}{300}$ of the amount required to establish contact by personal visits. Advertising can, therefore, be spread broadcast as a drag-net, while salesmanship must be reserved for specially remunerative territory. It is by advertising that the maker of goods can to some extent reëstablish that touch with consumers which was lost at the advent of the factory system. The relative influence of the manufacturer in the economic world, in comparison with the middleman, has been increased by it. The moral effect of advertising upon the one who issues it is that of being definitely committed, of having taken a stand of a public nature, of having invited the judgment of many, and of having conceived and written of ideals — ideals of healthfulness, cleanliness, safety, and economy. Upon the general public there can be no doubt but that the constant sight of announcements of high qualities in goods, and the constant reading of protestations of social service as the motive of business action, exerts an influence in the direction of elevating the standards of taste and of conduct. It is to be feared, however, that the constant drawing of the public thought to the consideration of goods, and to the carnal satisfactions involved in the use of goods, exercises a materializing

influence, and propagates the error that happiness lies chiefly in the possession of things.

Waste. — The amount spent in advertising in the United States annually has been variously estimated, by those concerned in supervising the expenditure, at between 600 million and 1,000 million dollars. There is no secret made by advertising experts of the enormous waste involved in this department of business effort. A recent text on advertising explains as follows: "Consider the case of a publication with 100,000 readers producing 3,000 replies and 300 sales. Such a result is a remarkable one viewed from the general average of practice, and yet it represents only three-tenths per cent efficiency of orders. The revenue efficiency might be less than the amount mentioned if the article in question was low priced and the orders represented small amounts."[1] The waste is from indiscriminateness — indiscriminateness in the choice of goods to make, in the choice of facts to present, in the choice of mediums to carry the message, and so in the choice of localities and times and individual consumers. Besides the waste of labor and material agencies, advertising involves a waste of the nervous energy of the public. It demands perception and an act of judgment from the majority of street-car patrons, to discover the few who want Spearmint gum. It flashes a dazzling array of electric lights before the eyes of the thousands who pass on a great city highway, to sift out a couple of hundred patrons for a rathskeller. In spite of a wastefulness like that of insensate nature, which showers down ten thousand acorns to secure a single oak sprout, or which spawns a million eggs to bring into being a single herring, advertising has established itself as part of the machinery of competition which is indispensable for the time being in many branches of industry. The individual advertiser may realize the waste, but he prefers it to economic extinction. He is like a poor swimmer

[1] Tipper, Hollingworth, Hotchkiss and Parsons, Advertising, N. Y., 1915, pp. 10–11.

who has had little training and loses three-fourths of the energy he puts forth, but who nevertheless prefers to continue to thrash the water rather than be drowned.

Administrative relations. — The advertising department should be a section of the selling department, the advertising manager working under the general supervision of the sales manager. Such a relationship recognizes the fact that advertising is one among a number of agencies of selling; and that it can only reach its highest efficiency when adjusted to work

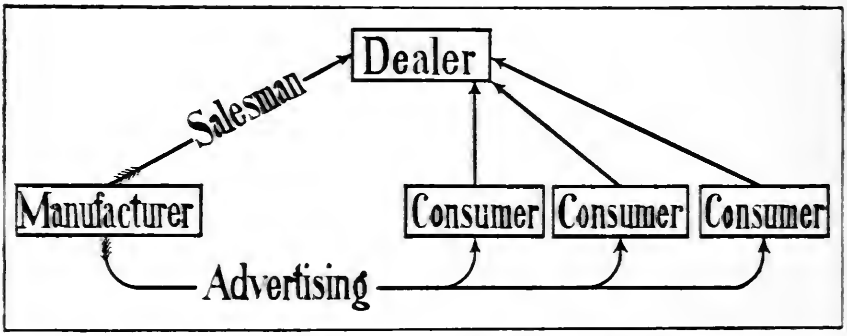

Fig. 46. The Place of Advertising in the Distributive Chain

harmoniously with the other agencies, in a general plan. It is the function of advertising to spread its message far and wide; to knock at many minds in the hope of entering a few, and of rousing them to write for catalogs, and so get themselves classed as prospective purchasers. But such effort is lost if the catalog is defective or the follow-up weak or offensive. Advertising opens the case, and presents the general facts, preparing the way for the salesman, who is to go into details with a personally adapted appeal, and "close." But such a case will be lost if the salesman is a grocery clerk who has not the goods in stock, and has never heard of them, but with ready wit presents a substitute. While it is customary for the manufacturer to carry on his relations with dealers by means of salesmen, the function of advertising is to appeal to consumers, and to induce consumers to apply to the dealers, in the hope that such appli-

cation will stimulate dealers to buy, and thus close the circuit and start circulation. But circulation depends on ability to bring the goods and the demand to the dealer at the same time.

Functions. — The functions of an advertising manager may be listed as follows:

1. Assist in the choice of an advertising agency.
2. Assist in the choice of a trade mark and a package, and in the determination of all the mercantile characteristics of the product.
3. Take part in preliminary studies necessary to secure the information on which the advertising campaign will be based.
4. Plan the initial distribution of goods.
5. Recommend the amount of the advertising appropriation.
6. Assist in the choice of advertising mediums.
7. Determine the size, position, and frequency of insertions.
8. Assist in the construction of the advertising literature.
9. Institute a system of records to deduce valuable results from the experience gained.

Agencies. — In many cases an advertising agency will be called upon to assist the advertising department of an individual business. Agencies have the advantage of special equipment and experience. They can estimate with some degree of accuracy the cost, length, and general character of campaigns which will yield the best results in any particular case. They have had experience as to the appeal of different kinds of copy. They can buy space with discrimination, for they know what results each medium has accomplished in previous campaigns of a similar sort. They can check up insertions and bill board displays cheaper than individual advertisers can do it.

The advertising manager who works with an agency will find among his functions that of obtaining copy which is stamped with the individuality of his house or product, rather than with that of the agency. It may be his duty to see that campaigns are not prepared too long in advance and put through

in a routine manner, but are kept revised in accordance with developments. He may find it necessary to exert an influence to see that the appropriation is spent carefully in special mediums, rather than distributed in an easier manner in large sums with prominent publications.

Preliminary studies. — Advertising aims to commit the producer, educate the consumer, supplement the salesman, convert the dealer, and eliminate the competitor. Chiefly, it is a link between producer and consumer; as such it can only be efficient when based upon a knowledge of products and of human needs. The expense of modern advertising campaigns, the necessity of continuing effort when a campaign is once begun, if the buds of inclination started by each appeal are to be ripened into actual demand by succeeding appeals; the fixity of design, trade mark, warranties, prices, and distributive agencies essential if the advertising is to be specific, and is to build up a system of distribution;—all these are circumstances which emphasize the need of making a careful preliminary preparation for a campaign. One of the best known advertising agencies has said, "Most of the failures in advertising come from guessing at things which could just as well be proved. We find out if an article can carry a precinct before attempting to carry the country.

"A house-to-house canvass develops selling arguments quicker than anything else. One has no idea how many theories are upset by facts until he meets his prospective trade.

"One of our ablest salesmen-in-print spent $1,000 worth of time, on one account, in tramping from farm to farm. He was learning what arguments would induce a farmer to put in acetylene gas. The advertising in question, ever since, has been founded on that information.

"To settle one point in one line of argument we sent out letters to 12,000 physicians. Before starting the advertising of Quaker Oats we spent three months on investigations, employing 130 men."

Choice of mediums. — Among the various mediums by which the advertiser can reach the consuming public, or the dealer, may be mentioned form letters, booklets, magazines, trade papers, house organs, catalogs, newspapers, and bill boards, not to speak of electric signs, window displays, and samples. These means are capable of classification in various ways: as national or local, of general appeal or class appeal, paid for by the consumer or thrust upon him.

Form letters, because of the small expense connected with them, may be used as a means of exploring a field and of securing information for the guidance of the major campaign. One successful concern uses form letters in batches of 500 to ascertain what classes of persons are their natural patrons. A batch will be sent to officers of a certain rank, as to presidents of banks, another will be sent to cashiers, a third to tellers, and so on; one batch will be sent to general managers of manufacturing corporations, another to sales managers, etc. The results of these appeals are tabulated, reduced to percentages, and compared. The same firm sends out letters at different seasons of the year. From such tests it has discovered that the profitable months for it are February, March, April, and September, October, and November; but especially March and September, with emphasis upon the latter month. Again, batches of letters of different composition and embodying different arguments have been sent out, as a result of which it has been possible to select the stronger forms of appeal and to eliminate the weaker ones.

A booklet is a printed letter elaborated as much as possible, without causing it to be separated from the first class mail. It provides more detail than a letter; but retains the informal and personal tone. It offers less information than a catalog; but like the catalog uses illustrations, and in some cases groups the subject-matter according to articles offered. It trusts much to artistic covers, and to the inclusion of disinterested information, to save it from the waste basket. In its appeal

to art it resembles the calendar, which is a little poster; in its incorporation of general information it treads in the steps of the ancient almanac. Booklets are now occasionally bound, since it has been discovered that a man will hesitate to consign a bound book to the waste basket.

Magazine advertising aims to give wide publicity to a firm's name and trade mark; and to create prestige for a product by the impression of extensive and permanent connections and respectable company. The dominant motives are, like those of the magazine itself, education and entertainment; a considerable degree of leisure, wealth, and refinement are assumed in the reader. Since the appeal is so widely scattered geographically, it is difficult to secure adequate distribution of goods in the hands of dealers. The advertisements, therefore, often contain arrangements for taking care of mail orders. The more usual plan is to bid for inquiries, stimulating these by the offer of samples or free booklets. The object of inviting inquiries is to secure letters which can be laid before dealers in the places of origin, as proof of the existence of a demand. When an adequate distribution of merchandise is finally made to dealers, consumers are referred to the local stores, and direct sales, or even inquiries, are no longer encouraged.

Trade papers are dominated by a professional or vocational interest. The audience is usually small but select, technically well informed, in earnest, influential, and marked by certain professional characteristics. The nature of the appeal to such an audience must be informational on the highest plane of accuracy as to facts. The trade paper assumes an important place in the distribution of those commodities which are bought on the advice of a dealer or professional expert. It is important for articles of intricate construction, and for things which must be installed by persons of experience.

A house organ may be described as a succession of booklets issued periodically in magazine or trade paper form, and sent to a permanent mailing list without subscription. It possesses

the advantage over the booklet of dignity, continuity, and economy in cost of printing and mailing. Following the model of a magazine, a house organ may contain a wide range of matter, such as news of the factory departments, helps for dealers, trade news, ginger talks, and humorous items. It thus provides a broad common ground upon which advertiser, dealer, and consumer may stand and get acquainted. The house organ is beyond the means of small concerns. It is exacting as to quality, and as to the regularity of issue. Its chief weakness is that it is laid upon a busy man's desk during his working hours.

A catalog aims to supply all information needed to place an order. Because of its expense it is usually to be distributed only to those who manifest a serious interest, either by making an inquiry for it, or by sending for a booklet, by purchasing an article, or otherwise.

Newspaper advertising belongs, in general, to dealers. A manufacturer may use it locally, however, to precipitate the uncrystallized good-will created by general advertising, in the form of a demand with the local dealer. The dominant idea of the newspaper is news. A paper a day old is dead. The reading is hurried. Advertisements must be striking, informal, and timely: a brief appeal for prompt action. The medium suffers from the heterogeneous character of its audience and, frequently, from the lack of censorship of the advertising columns.

The bill board, though endeavoring to trace its lineage back to the ancient and aristocratic tavern sign, was, in reality, born of the needs of the plebeian American circus. It received some refining influences in its early years at the hands of the theatre; but it has finally arrived at maturity as the chief agency of outdoor publicity, through being a "tax-payer" able to pay the carrying charges of unimproved real estate, and by reason of the standardization wrought by national associations of bill posters.

A poster is, at most, a picture in colors, with an epigram; reduced to its lowest terms it is a name or a symbol printed

large. Seen but for a moment, it must convey its message in a flash. Its audience is the average population of the street: the appeal is indiscriminate. It possesses many defects: among others that it demands attention from people who are occupied with making their way along the street and in avoiding passengers and vehicles. No two positions have the same value. It cannot be keyed. It is difficult to check up showings. The paper is easily defaced and is expensive to replace. Furthermore, there is an increasing section of the public which regards the bill board as the chief defacement of American cities. George Fitch has said, "The bill board not only reaches out and attracts the passer-by's attention, but it lams him with a club if he happens to be a man of good taste."

Advertising and the laws of attention. — The steps through which the advertiser attempts to lead the prospective purchaser are, a state of attention, an awakened interest, a memory impressed, and a determination formed to buy. The prehistoric struggle of the human race for survival has led to the production of a type of beings who give prompt attention to large objects, to objects the nature of which is not understood, to moving objects and those possessing the appearance of life, to objects of bright color, to sudden appearances and disappearances, to the first and last members of a series of similar objects and, in general, to all those things which contain a threat of injury or a promise of well being. There is in modern civilized life an intense competition of objects and ideas to become the subjects of attention; but the field of consciousness is very narrow, concerning itself with the things which are most comprehensible to us and which seem to us to be of most value. Of those things which are intentionally noted, and which can be recognized at a later time, but a small proportion acquire a tendency to be voluntarily recalled.

The earliest advertisers had the advantage of novelty: the field around them was silent. As rivals appeared and competition for attention increased, novelty became more difficult to

attain and a hunt for it began. This hunt has now become a strenuous breakneck race, with the public growing more and more blasé. Each new effect has its brief period of freshness, and then swiftly vanishes into the background of the commonplace. To travel down the principal street of a large city, or to look over the advertising pages of a magazine, is much like watching a football bleacher filled with yelling and gesticulating people, all intent upon attracting attention. It is not strange, therefore, that many of the devices used by advertisers to attract notice to themselves are strained, bizarre, and in ill accord with the sober merits of flour, shoes, soap, and breakfast foods. Long ago, we were softly appealed to by Millais' flaxen-haired boy blowing soap bubbles. Later, we enjoyed the gentle pun of the young lady of flower-like beauty, who held a big bag in her arms, and spoke of the flour of the family. But when now we see health pictured as an angel of mercy descending to relieve an invalid, but learn that the real message concerns a patent medicine; or we are shown an aged scientist toiling in his laboratory, but the subject proves to be merely the qualities of one of the innumerable brands of smoking tobacco; or we behold a prize fighter in the act of delivering a smashing blow, only to be told that a certain brand of canned soups will knock out indigestion, our principal feeling, if we pass beyond apathy, is one of disgust. The warfare on the consumer's steps is getting so obstreperous that there is needed a staff of economic detectives to stand between the consumer and the array of advertisers which is besetting him. The question is an open one whether this protection can best be assured by giving back to the merchant some of his old-time functions as the counselor and next-friend of the consumer, or whether it will come by evolving a new form of advertising censorship, carried out by publishers, equipped with scientific laboratories and investigating experts.

Advertising and interest.— Attention once secured, the advertiser's next object is to awaken interest. The process is the

simple but by no means easy one of holding the attention. That which retains attention must possess parts of sufficient complexity to invite renewed inspection; and must reward study by revealing new points of significance. A rational progression must be opened to the thought, and one which facilitates advance toward the goal-idea with which the mind of the beholder presently becomes possessed. Things interest us which are concrete and objective, and which mirror for us the world of the senses, rather than that of general concepts. Our interest is aroused when things reveal associations among themselves; and more so when they knit themselves onto our previous stock of knowledge, and reveal a new significance in old facts. Especially do things interest us which concern ourselves.

A table of the strength of appeal has been constructed by Mr. H. L. Hollingworth,[1] on the basis of laboratory experiments, as follows:

Appeal	Strength	Appeal	Strength
Healthfulness	92	Imitation	50
Cleanliness	92	Elegance	48
Scientific construction	88	Courtesy	48
Time saved	84	Economy	48
Appetizing	82	Affirmation	42
Efficiency	82	Sport	42
Safety	80	Hospitality	42
Durability	78	Avoid substitutes	32
Quality	72	Clan feeling	18
Modernity	72	Nobby, etc.	16
Family affection	70	Recommendation	14
Reputation of firm	58	Social superiority	12
Guarantee	58	Imported	10
Sympathy	54	Beautifying	10
Medicinal	50		

[1] Tipper, Hollingworth, Hotchkiss and Parsons, Advertising, N. Y., 1915, p. 85.

People are moved by pertinent truth, associated with pertinent emotional values. Indefiniteness of conception, or weakness in the association of the parts of a composite impression is fatal. Clearness, mastery, and veracity are characteristics which possess never-failing power to arrest the attention. To arouse interest is not primarily a literary process of dressing ideas in appropriate language: it is chiefly a matter of choosing the right ideas, and of bringing them out in the right order. Skill in this depends upon insight: and of insight we can only say, it is talent working with adequate knowledge of a subject. Successful advertising men are not, to any considerable extent, the products of literary training. Many of them are former newspaper men who, in their apprenticeship, learned to get at facts, and to choose from the multitude of facts those few things vital for a given purpose. It is marvellous how much a master of a subject can compress into a few sentences, and yet preserve an air of ease and freedom as if there were space to spare.

Few things are more fatal to interest than the suspicion of exaggeration. Whoever looks at an American railroad map, with its impossible straight lines, except for the purpose of amusement? The C. W. Hunt Company of West New Brighton, N. Y., manufacturers of machinery for handling coal and ore, say in the preface to one of their catalogs, "Readers of this and other catalogs and advertisements issued by the company are requested to bear in mind the fact that rhetorical expressions and superlative adjectives are rigidly excluded therefrom. It is our intention that every statement shall not only be correct in a business sense, but shall also be accurate in an engineering sense. When materials are mentioned, they will be designated by their correct engineering terms, and not by fancy, obscure, or semi-misleading names." How refreshing! How excellent their products must be, to permit of such restraint! Restraint refreshes interest, for it is a sign of strength held in reserve; and strength always attracts attention, for it contains the promise of future interesting revelations of itself.

Advertising and memory.—When attention and interest are assured, memory will be impressed in the degree that the matter put before the person agrees with his type of mental imagery. Memory is, in part, a function of the sharpness and vividness of the original impression; a matter which depends not only upon the material presented, but upon the occasion, the preparedness of the subject's mind, and the length of the observation. It depends also upon the frequency with which the impression is renewed. This is not the same as saying that it depends upon the frequency with which an advertisement is presented to the consumer. Attention soon passes over that which does not unfold new significance. The frequency which counts is that of the intentional apprehension; not of the approach, nor even of mere passive recognition. There is in advertising much stupid repetition which overlooks this point, and proceeds on the assumption that if a trade mark can be shown often enough to a reader, or an electric sign can be flashed frequently enough before the passer-by on the street, his trade must come as a mere matter of physics.

The fallacy of this is illustrated by the psychologist Meumann, who said, "I made systematic inquiries of a number of students as to whether they could describe the wall-paper of the rooms in which they studied; whether they could describe the dishes which they used every day at table; how many steps they ascended daily in the university stairways; whether they could name the buildings which they passed every day; whether they could describe or sketch the most striking church spires of the city; whether they could sketch the outline of mountain-peaks which they have seen often and attentively; whether the four upon their watch dials is indicated by four I's or by IV, and the like. To all questions of this sort one obtains exceedingly uncertain or even erroneous answers. Remembrances of every-day experiences are frequently so uncertain that the student becomes vexed and wishes to discontinue the experiment.

"These and similar observations prove that memory fails to retain many impressions that come to us countless times during our lives. They prove further that it is not the mere repetition of impressions as such which constitutes imprinting, and makes it possible for us to reproduce, especially to reproduce freely; on the contrary we find that, as a rule, we remember only what we have apprehended attentively and with the intention of remembering it." [1]

Memory is also a function of the number and strength of the associations which are established between an idea and other ideas in the mind; by virtue of which when any of the related concepts emerge into consciousness, the particular idea is drawn up also. We remember best those things which are easily classified and for which we can find an adequate word-symbol to serve as a name. In proceeding from one idea to another, in the act of recalling, we advance more easily from particular instances to general categories than in the reverse direction. We think more often of soap when "Ivory" is mentioned, than of "Ivory" when soap occurs to mind. Those things which present themselves to us as parts of a simple sequence, or as steps in a logical chain we recall most easily in the order in which they are learned: A, B, C, D, E, rather than E, D, C, B, A. Since the typical consumer's sequence is first the need and then the commodity, it is, as Mr. Hollingworth[2] has pointed out, more effective to advertise, "The best Christmas gift is a Copley print," than to advertise, "A Copley print forms the best of Christmas gifts."

Disagreeable associations are to be avoided. The disparagement of rival products is inefficient advertising, inasmuch as it causes defects to be recalled along with the advertised article, and leads to the conviction in the reader's mind that the class of

[1] E. Meumann, The Psychology of Learning, N. Y., 1913, Trans. by J. W. Baird, pp. 315–316.

[2] H. L. Hollingworth, Advertising and Selling; The Principles of Appeal and Response, N. Y., 1913, pp. 192–196.

articles in question is unreliable. One advertising expert has declared that as the result of the publicity of the Schlitz Brewing Company, he could not think of beer without thinking of "that skunky flavor." As a rule this law of association is well observed. None of the canned-beef concerns have exploited in their advertisements the fact that they supplied the United States Government during the Spanish War!

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CHAPTER XX

THE TRAFFIC DEPARTMENT

Administrative relations.— The traffic department should be a division of the sales department, the traffic manager being under the general supervision of the sales manager. In defense of such an arrangement it may be said that the delivery of merchandise to a carrier is an act more closely connected with selling than with manufacturing. Goods are shipped, where, when, and in the quantities ordered by the selling department. The cost of delivery is often absorbed as a part of the selling price, and so becomes an item the limits of which must be controlled by the same factors which control the general process of price setting. The selling department finds its field determined, in part, by the speed and cost of shipment. Errors in shipment, or delays, bring complaints to the sales department for adjustment, and may even require the sending out of duplicate merchandise.

The traffic department should furnish to all buying officers on request, information as to the length of time required to secure supplies from designated places, and as to the relative freight rates from rival supplying points. It will ship merchandise on order bills of lading, when instructed to do so by the credit department; and on the motion of the credit man it will exercise the right of stoppage *in transitu*.

Freight rates.— It is the chief business of a traffic department to compile information as to the rates of freight applying to the merchandise made or handled by the house, within the territory which constitutes the field of operations. The chief

factors which enter into the determination of freight rates are: (1) the value of the service to the shipper (a sum which may be measured roughly by the difference between the value of the merchandise at the initial point and the value of similar merchandise at the point of destination); (2) the cost of performing the service, including not only an indefinite share of the joint costs of carrying on the freight service of the carrier as a whole, but any special costs such as those for special cars, special switching, prolonged use of terminal space, the labor of tending, as in taking care of cattle, and the risk of loss, such as the liability of fruit spoiling, etc.; (3) competition with other carriers; (4) protection of vested interests; and (5) compliance with the requirements of law.

The first step taken by the railways in determining freight rates is to group the many thousands of articles which may offer themselves for transportation into a few classes, so that a correspondingly small number of class rates will provide a determination of the charge to be made in any individual case. The railroads of each great region are united in the support of classification committees. There are three classifications: Official, Southern, and Western. The Official classification, which covers the territory north of the Ohio and Potomac rivers, and east of the Mississippi River, Lake Michigan, and a line connecting Chicago and St. Louis, contains six numbered classes, together with six multiples of first class, as well as rule 25 which fixes a rate 15 per cent below second, and rule 26 which fixes a rate 20 per cent less than third, and rule 28 which lies midway between third and fourth. The Southern classification includes the region south of the Ohio and Potomac rivers and east of the Mississippi River. It consists of six numbered and seven lettered classes together with four multiples of first class. The Western classification, which covers the region west of Official and Southern territory, contains five numbered and five lettered classes and six multiples of first class. The classification of an article depends not only upon its nature but upon

the method of packing, crating, and boxing used, and upon whether or not the shipment is a carload or less. Classification committees influence rates, not only by assigning articles to classes, but by fixing the allowable minimum carloads, by determining the status of mixed carloads, by prescribing the regulations for handling bulk freight, by fixing private car mileage allowances, and by determining the precise nature of the various stipulations contained in the uniform bill of lading.

The classification being completed, the next step in rate making is for the individual roads to fix the rates to be charged for moving the different classes of freight between the stations on their lines. They also enter into joint rate agreements with each other on through business. A railroad may withdraw an article from its class and provide for it a special or commodity rate. This power has been exercised so freely that there are in existence hundreds of thousands of such special rates. As a rule commodity rates are lower than the class rates: they are applied chiefly to low-grade materials which are moved in large quantities.

Local and non-competitive freight rates are, in general, either straight mileage tariffs, or tariffs in which the charges increase with the mileage but not proportionally. Through rates are competitive adjustments between markets and between rival carriers. The initial through rates, which fix the bases for all others, are those between the great cities, and those which are established where the competition of ocean, lake, canal, or river carriers sets a definite maximum to rail charges. The determination of initial or base rates results in the establishment of certain places as basing points. Nearby points, or points highly competitive with the basing points, tend to take this base rate, and so to become common points with the basing point. The rates for other localities within the influence of the basing point, but so far removed, or so unimportant, that competition does not bring about a parity, will usually be adjusted

either as a percentage more or less than the base, or as an arbitrary sum or fixed differential more or less than the base rate.

In Official territory the foundation on which all other determinations are based is the rate between New York City and Chicago. Direct railway routes are made full rate or standard: the round-about ones, and the lake, ocean, and canal combinations are lower differential routes. The chief inland cities between New York and Chicago take rates composed by adding to a fixed terminal charge a mileage charge proportional to the distance. Such rates are represented in practice as a percentage of the through rate, and are applied, finally, throughout narrow concentric zones embracing a series of north and south points. Pittsburg takes 60 per cent of the Chicago-New York rate, Cleveland takes 71 per cent, Detroit 78 per cent, and Indianapolis 93 per cent. The even Chicago rate, or 100 per cent, applies to a zone passing southeasterly through Indiana to Louisville. Beyond this zone, as far west as the Mississippi River, localities are charged a percentage above the base. The St. Louis rate is 116 per cent of the Chicago rate. The Atlantic ports are balanced in their relations to each other by carefully measured fixed differentials: Baltimore and Philadelphia being given a few cents per 100 pounds advantage over New York. The port differentials, in turn, condition rates west from and east to nearby places: the Philadelphia rate applies to Wilkesbarre; the Baltimore rate applies to Altoona, Newport News, Norfolk, and to the chief inland cities of Virginia. New England is charged on eastbound shipments, originating west of Buffalo, Pittsburg, and Wheeling, a few cents over the New York rate, this rate being blanketed to all New England points. For shipments out of New England to Cleveland or beyond, the New York rate is charged.

In southern territory, rail rates along the Atlantic seaboard are dominated by the charges of ocean carriers. All-rail charges between northern and southern ports are a slight advance over water rates, representing the advantage of greater speed.

Rail-and-water rates are lower than all-rail rates for the region east of Knoxville, Chattanooga, Meridian, Montgomery, and Pensacola. The controlling base in the eastern South is the rate between Atlanta and the North. All northern ports have the same sea-and-rail rates to that city, while Atlanta rates are extended to the chief cities of western Georgia. The all-rail base in the eastern South is the rate from Baltimore to Atlanta. In the North this is built upon by giving to the eastern seaboard cities fixed differentials above the Baltimore rate, and by constructing back of each port a small common-point territory. In the South a few cities are made common points with Atlanta, while other important cities are given a differential either over or under the Atlanta rate.

In bringing the Northwest and the eastern South into relation, the first step is to equalize competition between the East and West. This is done by making the rate from all Ohio River crossings to Atlanta the same as the Baltimore-Atlanta rate. Cities north of the river add to the Ohio River rate the lowest local rate to the river, no matter which crossing the freight actually uses. St. Louis has the river rate plus a differential, while Memphis subtracts a differential from it. The central South takes rates from the Northwest which are differentials lower than the Atlanta rate. Freight moving into the Northwest from the South is composed chiefly of a few products, and is controlled by commodity tariffs. Local rates in the South are, for short distances, mileage tariffs. If the distances are considerable, or if there is competition, a basing-point system is used; that is to say, the rates are found by taking the combination to and beyond the last intervening important point, or to and back from the next basing point beyond, whichever may be the lower. North and south movements near the Mississippi River are calculated with reference to the Cairo-New Orleans charge, which is set low enough to discourage river traffic in everything except such low-grade freights as coal and lumber. Northern cities are charged fixed differentials over

this rate: intermediate points along the river are grouped into large common-point territories.

Texas internal rates are modified distance tariffs up to about 200 miles, beyond which they become flat rates, regardless of distance. For connections with the outside world a large part of that state is a common-point territory. Into and out of this region Gulf-and-sea rates from the East, via Texas ports, and all-rail rates via St. Louis, are adjusted upon a competitive basis. The St. Louis rate is then extended to a few competitors like Kansas City; while cities like Louisville, Cincinnati, and Chicago add a differential, and those like Memphis and New Orleans take one off.

East and west movements beyond Chicago are controlled by adjustments between the Mississippi and Missouri rivers. The main traffic points on the Missouri River from Kansas City to Omaha are made common points. To them Mississippi River rates from St. Louis to Dubuque inclusive are equal. From middle western cities to the Missouri River points, the rates are a differential over the inter-river base, and are the same amount whichever river crossing is used. From the far East to the Missouri River the rates are the same via St. Louis and Chicago. The Chicago-Missouri River rate is extended by giving it to Cairo as far north as St. Joseph, and to Minneapolis and St. Paul as far south as Nebraska City. Rates to the East from the states of the middle and northern plains are so adjusted as to secure a practical equality of charge whichever eastern route is used.

Colorado rates are based on Denver. To this city the Atlantic-Gulf water-and-rail rates are a small differential less than the all-rail rates through Chicago and St. Louis. Denver rates are shared by Colorado Springs, Pueblo, and Trinidad. Other points take a Denver and local charge, as does the territory lying between the Colorado common points and the Utah common points.

The next section of the traffic trunk extends from Denver

to Salt Lake City. For shipments from the Missouri River or from further east, the charge to Utah is less than the Denver rate plus the local charge to destination. This arrangement is made to permit Utah points to compete in the territory lying between them and Colorado points. The leading cities of Utah from Spanish Fork to Ogden are common points with Salt Lake City. In this section of the United States it becomes necessary to adjust the rates from New York via Panama and eastward from San Francisco, with the all-rail rates west.

The Utah general adjustments are extended to Montana common points. Montana points take the same rate from the East by way of Chicago or St. Louis. They also receive merchandise from Denver or Salt Lake City on a parity.

Rates from the eastern part of the United States into western inter-mountain territory add a greater or less percentage to transcontinental rates, depending upon the district of origin. Territory west of the Mississippi River is zone 1; thence east to a line passing through Chicago is zone 2; thence east to Buffalo and Pittsburg is zone 3; east of these localities, but short of the coast, is zone 4; while the coast is zone 5. From zone 1 the shorter haul may not be charged more than the longer one; from zone 2 it may be 7 per cent higher; from zone 3 it may be 15 per cent higher; and from zones 4 and 5 it may be 23 per cent higher.

To and from the Southwest charges are based on Santa Fe and Albuquerque, to which points the all-rail rate from the East is made equal to the combination of vessel freight to Galveston, plus the rail rate inland. Points west of these cities in New Mexico and Arizona take the Albuquerque through rate plus the local rate to destination.

Transcontinental tariffs are fixed in competition with ocean carriers. In the case of westbound through shipments, the Pacific coast cities are common points, and the rates to them are practically the same from any major point east of the Rocky Mountains for the higher classes, from any point east of the

Missouri River for the lower classes, and from any point east of the Mississippi River for commodity rates. Eastbound transcontinental rates generally advance at Colorado-Montana points, and again a little east of the Missouri River, while a third advance takes place a little east of the Mississippi River, and a final one when Lake Michigan or the eastern boundary of Illinois is passed. Most of the eastbound freight, however, is composed of a few commodities such as lumber and fruit, and is moved at special rates which blanket the eastern portion of the country.

The general effect of the American rate system is to favor large cities at the expense of small ones; to favor localities in which much of a given kind of freight originates in comparison with localities with a wider range of production; to favor certain articles which move at commodity rates at the expense of other things which are charged according to their class; and to favor shippers who possess such facilities as switches, switching engines, and short private lines, or private freight cars, in comparison with those who use the agencies provided by the carriers.

It is, of course, the particular business of a traffic manager employed by a private shipper to secure such knowledge of freight rates as applies particularly to the individual business. The rates may, for example, be tabulated by classes to various destinations, as illustrated by the subjoined comparison of charges in cents per hundred pounds from Detroit:

Change of rates. — New classifications are issued every eight or ten months, and each issue embodies hundreds of changes. The need of the shipper carefully watching the classification may be illustrated by the changes of June and July 1915. Supplement No. 18 of Official classification No. 42, which became effective June 2, contained changes of importance to shippers of dangerous articles, and of articles the rates of which are predicated chiefly on their value; supplement No. 20 of Southern classification No. 40, which went into force July 12, made

Rail Rates

From Detroit to —	Classes					
	1	2	3	4	5	6
Cleveland	31.5	27.3	21	14.7	11.6	8.4
Toledo	20	17	13	10	8	6.5
Buffalo	37.8	32.6	24.2	16.8	13.7	10.5
Chicago	38.9	33.6	24.7	16.8	13.7	10.5
Milwaukee	45.2	38.9	28.9	20	15.8	12.6
Duluth	85.3	72	54	38.1	31.9	25.6
Sandusky	25.2	23.1	20	13.1	9.5	7.4
Port Huron	22.1	18.9	14.7	10.5	8.4	6.8

drastic changes in many articles; supplement No. 6 of Western classification No. 53, which became effective July 15, contained changes of classification for 291 articles.

Since the passing of the Elkins law of 1903 it is no longer permissible for an individual shipper to bargain secretly with a carrier for rates. It is, however, still possible for a traffic manager of an industrial corporation, either singly or in association with others in the same industry or locality, to petition the classification committees for a reduction of the class of certain articles. Such a petition should recite the pertinent facts such as the relation of bulk to weight; whether the article is crude, partly manufactured, or finished; whether it is shipped loose or packed, set up or knocked down, crated or boxed; the market values in different localities, especially at shipping and destination points; the length and direction of the haul; the time of year carried; the amount of traffic likely to offer itself; and mention of any special labor required to handle it, or any special risk of loss incurred in transit.

The case for the granting of a commodity tariff, or the change of rate of such a tariff, has to be presented to the rate-making officer of the individual railroad, usually the traffic manager

or the general freight agent. The petition should elucidate the competitive conditions controlling trade in the article concerned, indicating the producing and consuming centres, giving the freight rates at which rival producers reach essential markets, and stating the rates the petitioners require in order to reach those markets on equal terms.

The power of the railways to favor a shipper is not limited to the making of a classification and the fixing of class and commodity rates. It involves a host of other matters, such as allowances for private switching, privileges of milling in transit, permits for partial unloading of carloads at intermediate points, rules as to mixed carloads, allowances of free packing material, methods of estimating weights, free storage time, special loading and unloading charges, and promptness or delay in furnishing cars. There is, consequently, a large field of effort in which the traffic manager can make himself useful to his employer, whether that employer be a private concern, or an association representing the interests of an industry or of a city.

Routing. — Each railway has in operation at all times a system of standard routings for freight moving to given destinations. These routings are based upon harmony of interest between the receiving road and some connecting carrier, upon joint traffic agreements, upon experience as to promptness in the return of cars, and upon the ease or difficulty with which trains are made up and broken up at different diverting points. The routing which the initial carrier prefers will commonly give the most speedy transit, but it is not necessarily the one which will give to the shipper the lowest rate. The problem of routing a shipment to a distant important traffic centre is a difficult one, especially if the initial point is also a large railroad centre. It involves not only the choice of the initial carrier but the formation of one particular chain of carriers out of numerous possible ones connecting the two places. American railway competition has developed an almost bewildering choice of roundabout traffic combinations offering service at different

prices. At one time the rate on grain in carloads from St Louis to Virginia City, Va., was $17\frac{1}{2}$ cents per 100 lbs., by the Official classification. At the same date it was 16 cents by the Illinois classification; but the rate from St. Louis to Louisville was then 4 cents, while the charge from that city to Virginia points by the Southern classification was 9 cents, or a total through rate of 13 cents. Mr. Stickney, President of the Chicago and Great Western Railway, tells of a traffic manager who found 11 different rates on the same article from his station to Boston. No railroad official will furnish a shipper with a systematic appraisal of the advantages and disadvantages of the different routes open to him. No public commission has yet undertaken to furnish such a digest of information. The shipper must depend upon his own traffic department, unless there is a local traffic association available.

Billing. — The classification books and the commodity rate schedules involve thousands of distinctions and definitions which determine what charge is to be made for shipments. Thus, Official classification No. 36 contains the following L.C.L. (less than carload) determinations:

Glass	1st class
Window glass, common, N.O.S.	Rule 25 [1]
Furniture, N.O.S.	Double 1st class
Filing cabinets, N.O.S.	1st class
Desks, N.O.S.	$1\frac{1}{2}$ class
Chairs, N.O.S.	$1\frac{1}{2}$ class
Stationery, N.O.S.	1st class
Pads of paper and tablets	3d class
Writing paper	3d class
Agricultural implements, N.O.S.	Double 1st class
Harrows or plows	1st class

From a commodity tariff we select the following mass of specifications as by no means unusual:

[1] See p. 398.

"Lumber."

"Sash, Doors and Blinds, unglazed, or glazed with other than plate, leaded or stained glass, released; Wooden Eave Troughs, Carpenter's Mouldings, Columns (turned), solid or built up and combined wood; Cornice Brackets, Wainscoting, Hand Rails, Balusters, and similar articles for inside finishing, manufactured of lumber other than Walnut, Cherry, Ebony, Rosewood, Mahogany, Lignum Vitae, White Holly, and Bird's Eye Maple, straight or mixed carloads, minimum weight 26,000 pounds. *Note.* — Glazed Sash must have glazed surface protected by boards not less than $\frac{3}{8}$ inch in thickness."

In general, the railroads will charge the highest rate which the description supplied to them will permit. Any package containing articles of more than one class will be charged at the rate of the highest classed article. A mixed carload, as a rule, takes not only the highest rate of any article in it, but exacts the highest minimum carload weight prescribed for any of the constituent articles. It is obvious that a traffic manager, who is familiar with billing terminology, can honestly describe his shipments in making out the bills of lading, and yet secure transportation at rates materially lower than would be assessed if the designations were vague and general. A shipment can often be divided to advantage; the high-rate articles being packed and shipped separately from those which take a lower rate. Less frequently, there is economy in combining diverse articles in one shipment, under the rules for assessing mixed carloads.

Size of shipments. — The class and commodity tariffs all contain specifications as to the minimum weight to be charged for at carload rates. These weights should, of course, be actually shipped where possible, when paid for. A few examples of minimum carload weight regulations, chosen from Official classification No. 36, will show the range:

The complete utilization of car spaces sometimes depends upon the forwarding of consignments larger than a carload.

Article	Minimum carload weight in lbs.	Class L.C.L.	Class C.L.
Crêpe or crinkled paper in cases	10,000	1	2
Bananas	18,000	1 and $1\frac{1}{2}$	3
Farming mills, K.D. flat	20,000	1	5 (R27)[1]
Acetic acid, in carboys boxed	24,000	1	5
Acetic acid in bbls. or iron drums	36,000	3	5
Ale and beer, in bottles packed in boxes or bbls.	28,000	3	5
Asphaltum, solid, in cakes, bags or bbls.	40,000	4	6
Pig iron, chill	56,000	4	6

The Ford Motor Company of Detroit can ship 6 machines in a freight car, but if 10 cars are being loaded at one time for a single destination, it is possible by a rearrangement of packages to send 100 machines.

Packing. — The nature of the package and the method of packing frequently exert a decisive influence upon the rate charged. A spread of one class, and sometimes more, separates shipments set up or knocked down, crated or boxed, and nested or not nested. An extract from the classification will serve to show the possiblities of economy:

Article	Class L.C.L.	Class C.L.
Children's carts, N.O.S.:		
Not crated or boxed L.C.L.	not taken	
Minimum weight 10,000 lbs. (subject to Rule 27)		R 25

[1] Rule 27 makes the minimum carload weight depend upon the length of the car used.

Crated or boxed		
S.U. (set up)		
Wheels on....................	3 times 1st	
Wheels off....................	Double 1st	
K.D. (knocked down) or folded (not flat)		
Wheels on....................	Double 1st	
Wheels off....................	$1\frac{1}{2}$	
K.D. flat........................	1	
Minimum weight 10,000 lbs. (subject to Rule 27)...........		R 25

The importance of containers may be illustrated by the rating of one article; in this case paint:

Article	Class L.C.L.	Class C.L.
Paint, N.O.S., in oil		
In glass, packed..................	1	3
In buckets or kits (C.L. minimum weight 36,000 lbs.)..............	3	5
In cans, jacketed, loose............	1	
In tins cans or tin pails, loose.......	Double 1	
In sheet iron or pressed steel cans or pails, loose (C.L. minimum weight 36,000 lbs.)..............	3	5
In tin or sheet iron cans or pails in crates, boxes or bbls. (C.L. minimum weight 36,000 lbs.).........	3	5
In iron drums (not cans) (C.L. minimum weight 36,000 lbs.).........	4	5
In kegs, half-bbls., or bbls. (C.L. minimum weight 36,000 lbs.)..........	4	5

It is estimated that freight claims amount to between 2 and 3 per cent of the value of the merchandise transported on Ameri-

can railroads. Of this great sum, damage accounts for between 60 and 70 per cent. The chief cause of damage is inadequate or inappropriate packing and packaging. This does not mean that the package is always too frail; much of the loss is due to parts being left loose to move about within the package. When light and heavy articles are put in the same package, and loosely packed without inside bracing, the heavy articles tend to perform the function of a hammer, upon the lighter ones. Many packages are made so large and heavy as to constitute a standing challenge to the freight handler to enter into a wrestling match with them.

Any time which is saved in the processes of packing and shipping has the effect of bringing a supplying concern as much closer to its customers (in terms of economic distance) as shipments will usually advance in the hands of carriers in an equal length of time. Efficiency in these operations serves, therefore, to add to the tributary territory a broad belt at the outer margin. Every hour wasted contracts the radius of profitable operations from 12 to 20 miles: every hour gained lengthens this radius by an equal distance.

Trucking. — What has been said of packing applies with equal force to trucking. Until recently, trucking has been one of the most inefficient branches of transportation. Presided over by the itinerant drayman, it has been slow, destructive, and unreliable. This situation is being changed by the introduction of motor trucks, which have brought into the field the scientifically trained engineer. As to the economics of the motor truck versus the horse-drawn vehicle, it may be said that, since the motor truck has a greater hourly cost than the team, but also a greater speed, when the motor is standing still it incurs a greater hourly loss than the idle team, but when the motor is in motion it attains a lower ton-mile cost than the moving team. The principle of economy is then to use motors for the longer runs and the more continuous schedules, and to reduce idle time to a minimum by adequate apparatus at load-

ing platforms, and by the application of motion study and the rules of scheduling to all work which holds the truck in waiting.

The securing of cars. — It is the duty of the traffic department to notify the railways when cars are needed for carload shipments, and to do this sufficiently in advance of requirements so that merchandise will not be delayed.

The traffic officer should be familiar with the mileage allowances made by the railways to owners of private cars, so that he can calculate under what conditions it will be an economy for his employer to purchase rolling stock. It may be said, in a general way, that while the earnings now being made by the owners of private stock and tank cars are not excessive, those of the owners of refrigerator cars are very high.

Fast freight service. — The traffic department should be familiar with the character of the fast freight services available on the railways patronized. Such services, variously known as "fast," "time," "preference," and "manifest" freight, or designated by some arbitrary title such as "Red Ball" (A. T. and St. F.), "Star Union" (Pa. R. R.), or "Merchants' Despatch" (N. Y. C. Lines), offer through service at an average speed of about 20 miles per hour, as compared with the 12 miles of the ordinary freight train. The traffic department should know the schedules of such trains, the receiving and discharging stations served by them, the classes of freight handled (especially whether or not package freight in through or peddler cars is included), and should be familiar with any special billing procedure which may be required.

Demurrage. — The general practice of the railroads, under the national car demurrage rules, is to grant 48 hours free time in which to load or unload a car, and 24 hours for reconsignment, holding for switching orders, stoppage for partial unloading in transit, inspection, and grading. This free time is adjusted to begin approximately one-half day after the car is placed. For holding a car beyond this time a charge is made at the rate of $1.00 per day. Free time may be extended by reason

of Sundays and holidays, bad weather, delayed or improper notice, or other errors made by railway employees. There are many cases of car delay which are exempt from the application of demurrage rules.

When a shipper handles a number of cars in a month he may enter into an averaging agreement with the local demurrage bureau. The rule of averaging is as follows: "A credit of one day will be allowed for each car released within the first twenty-four hours of free time. A debit of one day will be charged for each twenty-four hours or fraction thereof that a car is detained beyond the first forty-eight hours of free time. In no case shall more than one day's credit be allowed on any one car, and in no case shall more than seven days' credits be applied in cancellation of debits accruing on any one car." In most of the Southern states and the states lying between the Mississippi River and the Rocky Mountains, demurrage rules have been established by state law. These laws as a rule establish reciprocal demurrage, and lengthen the period of free time. Under reciprocal demurrage the railroads are assessed for delay in furnishing cars or in moving them, at the same rate that the shipper is assessed for holding cars.

Rebilling, reconsignment, and stoppage *in transitu*. — One of the functions of forwarding agents and transfer houses is to receive freight in carloads from their principals, place it in storage, and ship it as instructed in L.C.L. lots to designated consignees. By employing such agents a shipper can place reserve stocks in market centres, situated conveniently to groups of customers; and can secure the economy of carload rates part way to destination, without incurring the full expense of maintaining a system of individually owned branch agencies.

A shipment can be consigned to a certain point and later reconsigned to a point short of or beyond the original destination, providing instructions are given to the railway before the shipment has passed the last freight-distributing centre at which change of destination can be made. If the intermediate desti-

nation points of a series of consignments applying to one shipment are on the direct route to the ultimate destination, the railroads will allow the through rate to apply, plus a charge for reconsignment.

Goods shipped to a buyer on a straight bill of lading, when freight is not prepaid, are, in general, held to be the property of the consignee, while in the hands of the carrier. If, however, goods are being shipped from a seller to a buyer on credit, and during the progress of the shipment, or while the goods are still in the possession of the railway at the consignee's station, it is discovered that the buyer is a bankrupt, the seller has the right to order the carrier not to make delivery, but to hold the merchandise subject to his orders. This is called the right of stoppage *in transitu*.

Freight claims. — The railways are liable for loss, damage, wrong delivery, delay, and overcharge, together with interest on the sums involved. The responsibility is limited to direct losses; that is to say, if the paper of a daily newspaper were lost, the responsibility of the carrier would be for the value of the paper, and not for the indirect and consequential injury which might result from suspension of publication. Delay beyond a reasonable time involves responsibility where there is a discrepancy between the market value of the goods at the time actually received and the value at the time they should have been received. The responsible railway is the one issuing the bill of lading. Liability is to the consignee in the case of a straight bill of lading; to the consignor, or person to whom he endorses, in the case of an order bill of lading.

When damaged or short shipments are received, the proper procedure is to accept the freight, upon the proper notation being made by the freight agent upon the receipted bill, and then to file claim. In case of concealed damage or loss, notice should be given to the agent in writing at the earliest possible moment, and an opportunity offered him to make inspection. Claims for shortage often involve the meaning of the endorse-

ment "shipper's load and count" on the bill of lading. The use of this phrase does not constitute a waiver of the shipper's right to recover for shortage, but it does lay upon him the burden of proof that the quantities claimed were actually delivered to the railway. In such a case a set of business-like records made by the packers, checkers and draymen is of great assistance.

The general improvement of railway service. — The traffic men of a branch of industry, or of a locality, can exert considerable influence in the direction of improving railway service, particularly if they are organized. In Cleveland, a section of the Chamber of Commerce serves to bring railroad officials and industrial traffic men together, and to create an atmosphere of friendliness and reasonableness between them. There has been established, through its efforts, a system of reporting delayed shipments which has spread among the railway agents of a considerable area of country the idea that if Cleveland freight is delayed without good excuse the matter is heard from. In St. Louis the Freight Bureau of the Business Men's League handles complaints for the members of the League. It also compiles a handbook of outgoing package car service, which enables a shipper to discover at once to what points there is special service, and at what hours the various cars are moved. The Bureau prepares a monthly statement of the times actually taken by these cars in reaching destination. This publicity sharpens the ambition of the railways to maintain their published schedules; and it enables shippers to guarantee delivery dates so closely that their retail customers are encouraged to practise the system of placing light and frequent orders.

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CHAPTER XXI

CREDIT AND COLLECTION

Credit

Commercial credit is the sale of merchandise on the promise of future payment. It rests upon confidence in the ability and disposition of the debtor to fulfil his obligations. To give to another person credit means to make a short-time investment in his business; to stake one's money on the location and methods and talent of a particular firm, as over against competitors. Credit permits men who have more property than opportunity to aid those who have more opportunity than property. It is one of the great agencies for the more general distribution of economic power. Credit is a creator of opportunity, "it opens the careers to the talents," as Napoleon's merit system did. To give credit with care means to encourage honest and capable men as proprietors of business, and to discourage those who are dishonest or incapable; it is to be on the still hunt for men with the talent to use, conserve, and increase property. It means to encourage well-conceived and soundly managed enterprises, and to aid in the elimination of the opposite sort. To refuse credit when it should be refused is not an act of illiberality; it is the necessary correlative of an act of discriminating liberality which will help forward some worthy man.

From the point of view of mercantile credit, the ideal credit-giving institution is not a bank but a business in the same general line of industry as the businesses to which advances are made, and prior to them in the chain of commodity distri-

bution. In such a business every aspect of the affairs having to do with the sale of goods will contribute knowledge useful in administering the credits. Furthermore, the credit-giving institution should be large enough to average risks.

Administrative relations. — In a business of sufficient size to bear the elaboration, the credit man should be independent of the selling department, and coördinate in authority with the sales manager. The separation of functions involved in such an arrangement is desirable because the handling of credits and the making of collections is a matter distinct in point of view, in principles, and in technique, from the making of sales. The administrative independence thus attained for the credit department will create within a business an influence which has to do with the marketing process, but which is able to correct the extravagancies into which the optimism and push of the selling temperament occasionally lead.

In businesses so small that there is not enough work to occupy a man entirely, it is not unusual to put the credit man in charge of accounts, and even to give him the duties of cashier and treasurer. In behalf of such a combination of functions it may be said that the relation between accounts and credits is close. Most credit men are graduates of the accounting department. It seems reasonable that the man who is applying tests to discover the soundness of other businesses, and who is constantly thinking of such matters as the apportionment of capital to different uses, and the adequacy of accounting systems and balance sheets, should be made the watchdog of the treasury of his own concern.

The general credit policy. — The policy used in extending credit and in making collections should be harmonized with the remaining body of policy of the business establishment. An enterprise with small capital will aim at rapid circulation of its assets by offering liberal discounts for cash, by energetic treatment of slow accounts, and by accepting notes which can be used as collateral for loans. An industry with a marked

seasonal irregularity will be inclined to develop the practice of giving long terms, to induce advance ordering, while yet obligating customers to pay their bills as they realize upon their stocks. An establishment in an out-of-the-way location will see that it can devise easy terms for distant territory, and so practise market equalization by means of credit as well as by absorbing excess freight charges. A national advertiser may find it profitable to make a special concession to the initial dealer in each locality, for the sake of obtaining numerous outlets through which to "cash in" the good-will created by his advertising. A new firm may attempt to neutralize the advantage of older rivals by financing dealers more scientifically, and with a more intimate and helpful credit service, than its competitors have done. A new firm will seek to grow with rapidly growing territory, by distributing its credit favors in young neighborhoods, and with new firms.

Datings. — The technique of payment involves such matters as datings, interest calculations, and the medium of payment. A dating is an adjustment of the date of a bill so that an account will fall due some time after the merchandise covered by it has been delivered, and will permit the taking of the cash discount at a correspondingly postponed date. The force which more than any other tends to lengthen credit terms unduly — competition aside — is the seasonal irregularity of trade. This irregularity accounts for the long terms of agricultural credits. And it accounts also for the long terms which sometimes prevail between manufacturers and their wholesale distributors, and between wholesalers and their retail customers, where there is in use a system of ordering merchandise in advance of seasonal demand.

Discounts. — The interest calculations involved in payment have to do with discounts offered for anticipation, or for prompt payment, and with the interest charge exacted as a penalty for delay. The majority of the concerns which sell to dealers allow a discount for payment within a few days after

the date of the bill. The most frequently employed terms are probably "2–10–30–6," which mean 2 per cent discount for cash in ten days, and interest at 6 per cent after 30 days. Prices stated in terms of time, under such an arrangement, are as follows:

Time	Price
0 to 10 days, incl......	Net, or 2 per cent less than the face of the bill.
11 to 30 days, incl......	Face of the bill.
31 days and over......	Face, plus interest at the rate of 6 per cent per annum.

The allowance for payment in 10 days is at the rate of 73 per cent per annum: a rate which stands in marked contrast to the 6 per cent per annum designated for the overdue account. The rate of the cash discount cannot be justified, therefore, as interest for the use of the money for the period. Credit-giving concerns are able to borrow money at a fraction of this rate; and the debtor business which is sound and well managed can borrow money with profit to discount its bills. The high rate of discounts is intended to stimulate debtors to prompt action, and so prevent accounts from slipping into that "old" stage where they are hard to pay. In so far as the psychology of debt paying is concerned, obligations are easiest met when incurred, for at that time the sense of contract obligation is strongest, and the value of the merchandise received is most vividly realized. At that time, also, the inflation of assets caused by the receipt of new units of capital in the form of goods has not yet exerted a palpable influence toward affluent methods of finance, from which it is hard to return to the more cramped calculations of doing business on one's own capital. When the cash discount system is used, normal prices are the net prices and the discount is an extra charge made to those who are slow: a charge intended to compensate for the extra hazard and the collection-department expense their accounts involve. By

making this fine for slowness a heavy one, the cash-discount system serves as a convenient touchstone of debtors, classifying them sharply into two groups, those who are standard and competent, and those who are sub-standard and who require a careful and costly nursing process.

Payment in securities. —But one point requires mention with reference to the medium of payment. It is not unusual for the manufacturers of building materials or machinery used as equipment by other corporations to be approached with the proposition to take in payment the stocks or bonds of the buying corporation. If such a supplier has an alliance with a financial house which is in the business of underwriting, and of distributing securities, the task of examining into the merits of such propositions can be turned over to experts, while in case the securities are finally accepted, there will be at hand the organization for marketing them with the investing public. Such a combination between manufacturing and underwriting exists in the case of engineering promoters.[1]

Credit information. — Credit rests, as has been said, upon the debtor's ability and disposition to fulfil his financial obligations. It has to do, therefore, with character and with business conditions. Two things are to be judged: a man and his business. The judgment of both will involve the consideration of the prevailing state of business of the region and of the country.

The personality of the applicant for credit involves an inquiry into such matters as health, age, training, talent, application, economy, and fitness for the particular enterprise concerned. One-fourth of the failures are due to incompetence. It involves, also, the question of honesty — over one-tenth of the failures are due to fraud. The chief function of the credit manager is to hazard the property of his firm with the right man. It is easy to pick the present leaders of industry: the fine art of character analysis is only shown in discovering talent which is yet

[1] See further Chapter II, pp. 25–26.

in embryo, and in choosing those who will be the leaders of tomorrow. The highest compliment which can be paid to a credit manager is to have many successful men say of him, "He helped me when I needed help." Such a manager has cast his bread upon the waters to good purpose.

To judge the general conditions of business which effect credit advances is not only to determine in what phase of the trade cycle the country is at any time, and decide what the next phase is likely to be, but it is to review the prospects of a particular branch of industry, and to estimate the conditions which determine the prosperity of a locality. Some industries are in a state of speculative overdevelopment; others are involved in a general process of integration into large units which will crush out many small establishments; still others are being rendered obsolete by mechanical invention and the evolution of new methods of mercantile distribution. Some localities are cursed by non-periodic climatic changes which bring years of crop failure; others are single-line manufacturing districts, liable to be paralyzed by strikes, or to fall suddenly from prosperity into depression; still others are dependent upon a business of wasting assets, like lumbering or mining, which will eventually work out the local supplies and move elsewhere.

In reviewing the affairs of the individual debtor firm, the credit man is interested to learn the amount of assets, the character or distribution of the assets, the rate of turn-over or the intensity of the use of the capital, and the cost of doing business or the efficiency of this use. The total amount of the assets determines the safe limit of total advances from all creditors, for the proprietor's contribution is in the nature of a margin of safety. "On the supposition," says P. R. Earling, "justified by experience, that the assets of a mercantile firm, in the event of foreclosure or assignee's sale, do not bring over 65 per cent, the limit of credit, to insure us dollar for dollar, must be fixed at 65 per cent of the inventory value of the assets.

If we start with $10,000 of assets, this would pay liabilities of $6,500, and this amount must be established as the limit, and in all cases this relative proportion should be maintained. The shrinkage of 35 per cent represents the capital invested, but creditors are paid in full, and this is as it should be. The man who embarks in business is supposed to risk his capital, and not ours, in the enterprise; and in case of loss or failure, we, as prudent business men, should look to it that there is sufficient margin represented by capital to provide for emergencies." [1]

The most widespread and inveterate mistake made in handling assets is to fix too large a proportion of them in forms from which cash cannot be secured quickly without excessive loss. When the sales and expenses of a business can be compared with the total credit advances made to it, the proper term of the credits can be calculated. If a firm makes annual sales of $100,000 with expense of $20,000, and so has a sum of $80,000 applicable to debts, the payment of claims should proceed at the rate of $222.22 per day, if the entire amount is applied. If the debts average $25,000 this would mean that, where an even rotation was observed, any particular account should be paid in 112 days. If then an account stands longer, the delay suggests that there is either favoritism, increase of indebtedness, or diversion of funds.

Exemptions. — In scrutinizing the property of a customer with reference to its value as a margin of safety for credit advances, it must be remembered by the credit officer that the law does not consider it good policy to permit a debtor to be entirely stripped of his possessions and thereby handicapped in his efforts to earn a livelihood for himself and his dependents. Exemptions of personal property, including wearing apparel, tools of the trade, work animals, and household furniture, range under state laws from $300 to $500 in value. The homestead exemption of home or farmstead covers values ranging in

[1] Whom to Trust, Chicago, 1890.

PROPERTY STATEMENT BLANK

Recommended and endorsed by the National Association of Credit Men

To....................*Date*..........19

For the purpose of obtaining credit now and hereafter for goods purchased, I or we herewith submit to you the following statement of my or our resources and liabilities, and I or we will immediately notify you of any material change in my or our financial condition.

In consideration of your granting credit to the undersigned I or we agree that in case of my or our failure or insolvency, or in case I or we shall make any assignment for the benefit of creditors, bill of sale, mortgage or other transfer of my or our property, or shall have my or our stock attached, receiver appointed, or should any judgment be entered against me or us, then all and every of the claims which you may have against me or us shall at your option become immediately due and payable, even though the term of credit has not expired. All goods hereafter purchased from you shall be taken to be purchased subject to the foregoing conditions as a part of the terms of sale.

Active Business Assets	Dollars	Cents
Value of merchandise on hand at cost........................		
Notes and accounts, cash value.....		
Cash in hand..................		
Cash in bank..................		
Fixtures, machinery, horses and wagons.....................		
Total Active Business Assets..		

Business Liabilities	Dollars	Cents
Owe for merchandise, open acct., of which $......is past due.....		
Owe for notes for merchandise		
Owe bank.....................		
Owe others for borrowed money...		
Owe taxes and rent.............		
Mortgages on fixtures, machinery, horses and wagons.............		

Total Business Liabilities . . . .

Net Worth in Business . . . . . .

OUTSIDE ASSETS

Total real estate, assessed valuation, $.	
Total encumbrances on real estate, $.	
Equity	. . . .
Personal property.	. . . .
Other assets.	. . . .
Grand Total net worth in and out of Business.	

Full given and surname of each partner	Age?	Married?	Possible liability of each member of firm as endorser, bondsman,etc.
. . . .	. . . . . .	. . . .	. . . .
. . . .	. . . . . .	. . . .	. . . .
. . . .	. . . . . .	. . . .	. . . .

What portion of Real Estate described is homestead?. . . . .

Have you any other debts than herein mentioned?. . . . .

What kind of business do you conduct?. . . . .

Insurance on Stock? . . . .

On Fixtures, Machinery, Horses and Wagons?. . . . .

On Real Estate?. . . . .

Amount of sales last year?. . . . .

Amount of expenses last year?. . . . .

What proportion of your sales is on credit?. . . . .

How often do you take an inventory of stock? . . . .

Date of last inventory? ....

If you have borrowed money in the business, state what amount is secured and in what way? ....

....

Are any merchandise creditors secured in any way? ....

Have you any judgments, judgment notes, chattel mortgages, or other liens against you, recorded or unrecorded? If so, describe

....

Suits pending, and of what nature? ....

....

Keep bank account with ....

....

What books of account do you keep? ....

....

If you have pledged or transferred outstanding accounts or property remaining under your control, state amount thereof and amount received, or to be received, on account of such pledge or transfer.

....

The above statement, both printed and written, has been carefully read by the undersigned and is a full and correct statement of my or our financial condition as of ....19....

Firm Signature ....

By............................a member of the firm.

Town .... State........................

On the reverse side of this sheet is given a list of houses I or we deal with.

the different states from $100 to $1,500, although in a few states it amounts from $2,500 to $5,000. The homestead right is sometimes stated in terms of acres. The income exemptions, applying to wages and salaries, usually range between $30 and $60 per month.

Sources of information. — The ideal source of information on which to base a credit advance is the debtor's own statement. The ideal statement is one including a signed schedule of assets and liabilities. To assist the applicant for credit in preparing an acceptable statement, a property report blank has been published by the National Association of Credit Men.

Applicants for credit are sometimes loth to give complete information as to their affairs. On this point the National Association of Credit Men says, "The giver of credit is a contributor of capital, and becomes, in a certain sense, a partner of the debtor, and as such has a perfect right to complete information of the debtor's condition at all times." False pride should not be a bar to the giving of a statement, for it may be assumed that those who ask for credit need it, and that therefore the balance sheets they present will not show ideal financial conditions. Honest persons should welcome a chance to put themselves upon a basis which those who have much to hide cannot attain. Those who are ambitious to rise should realize that it is profitable to establish confidence in the minds of those who have the means to aid them. There is every reason why the relations between a credit man and the customers of his firm should be a close and candid one. The business interests involved are in natural accord, since a credit-extending house can only prosper through the prosperity of its customers. Furthermore, the credit man is the best financial doctor most business men ever have the privilege of coming into close touch with.

A complete financial statement is especially desirable from those who are placing a first order, from such as have no credit rating with a mercantile agency, or who claim that their rating

is unjust or out of date, from customers who desire to place a new order before an old one is paid for, and from those who are asking for an extension of time.

The most comprehensive source of information available to the credit man, and the one next in quality to customers' own statements, is the ratings and reports of the mercantile agencies. Salesmen's reports are to be utilized chiefly as a supplement to customers' statements, and as a running fire of current comment to keep the credit histories in the credit department revised to date. Bank reports are reliable but reticent: bank officials do not desire to perform the work of mercantile agencies. Other sources of information are the reports of organizations of local credit men, commonly known as credit clearing houses; the reports of the credit bureaus of national trade associations, and the interchange of information which takes place, by courtesy, between the credit departments of different houses.

The credit office.— The office system of the credit department is directed to the systematic recording of items of information bearing upon the credit standing of customers, and to the rapid review of the purchase orders received, in the light of this information. The office procedure should be designed to bring customers' accounts to the attention of the credit man as infallibly as possible upon the occurrence of certain designated junctures which are deemed dangerous. Such junctures may be:

(*a*) account overdue,

(*b*) line of credit used up,

(*c*) rapid increase in orders above previous average,

(*d*) an unusually large order placed by a slow-paying customer, who has recently been paying very promptly,

(*e*) an unjust claim — as of shortage or damage — when the circumstances are not convincing; especially a repetition of such claims,

(*f*) fire under suspicious circumstances; especially a second fire,

(*g*) refusal to honor draft,
(*h*) refusal to furnish financial statement,
(*i*) report of unfavorable items of legal record.

Collections

When an account falls due it becomes not only a credit but a collection as well. The process of collection is one of the most difficult of business negotiations, for while it requires the application of pressure to induce debtors to perform an unwelcome act, the means used must usually be confined within limits which preserve the business connections. Tact must be blended with firmness; but since these two principles of conduct tend to fly toward opposite extremes — tact toward obsequiousness, and firmness toward harshness — the most difficult virtue to achieve in a credit department is the blending of the two.

The stages of a collection. — The history of a collection may be represented as a series of steps:

1. A statement should be presented at maturity. It is customary among many classes of merchants to collect individual items into monthly statements; manufacturers, on the other hand, generally present each invoice as a separate bill. If bills are sent out promptly the impression is created that a house interprets its selling terms strictly, and expects business-like treatment at the hands of its customers. Promptness is everywhere interpreted as evidence of decision of character; it tends to promote respect and an attitude of compliance. It is not wise to enclose advertising matter with statements, since to do so is to attract attention from the main purpose of the communication.

2. A statement disregarded should be promptly followed by a firm and candid follow-up. Promptness not only avoids a portion of the labor of watching accounts, and saves the interest and business profit of the funds otherwise locked up, but it allows less time for unfavorable changes to occur in the debtor's affairs. It is a mistaken analysis to assume that a customer's

patronage is held by letting an old debt drag. Debtors who feel that they have overtaxed a creditor's generosity avoid contact, fearing a dun. They are more comfortable with a new concern where their credit is temporarily better. Debts long postponed are notoriously hard to pay. During the delay the debtor enjoys the use of the property of another, and this false situation gradually breaks down his value sense. The longer he remains in this comfortable state, the more disagreeable, and finally even unfair, it seems to him to be obliged to change. "Time adds frightfully to the risk of the deal from the credit point of view," says The Studebaker Brothers Manufacturing Company, in its instructions to its salesmen. "A dealer with limited responsibility is a better risk for reasonable credit on short time than a dealer with twice his means on long time."

3. The use of a sight draft is a recognized process of collecting, and one which should give no offense, provided it is known that a house makes a practice of using it regularly. To establish the practice as standard, some firms insert a printed notice in their statements to the effect that delay in payment is understood to mean that they should draw. A draft should preferably be presented through the bank with which the customer deals in his own town. It will, in such a case, be less willingly dishonored; and it will be in the hands of the bank most disposed to grant financial assistance.

4. A dishonored draft brings a collection to a critical point where thorough investigation is needed before taking further steps. Investigation may lead to any one of several courses of action: (*a*) An extension of time may be granted, coupled, if possible, with partial payment and, in some cases, by the obtaining of security. A series of notes may be arranged to fall due at intervals. "More men," say the Studebaker Brothers, "will meet promptly three small payments with intervals of time between than the aggregate of the payments at the average time. The dealer usually must lay by money in advance to meet a considerable payment, and there is always danger that

he will use this fund for some other purpose, either to make purchases which are urged upon him, or to satisfy some intervening creditor." (*b*) An account may be transferred to a collection agency if the credit department is not strong. (*c*) The last stage of a collection lands it either in the hands of an attorney, or in the list of bad debts charged up to profit and loss.

5. The entrance of an attorney ends amicable relations. All collection efforts short of suit should, therefore, be made before an account is placed in the hands of an attorney. This is equivalent to saying that the use of an attorney in prolonged efforts at collecton is a mistake. An attorney should demand settlement or security; if neither is forthcoming, suit should be begun or the matter finally dropped.

Credit adjustment bureaus. — When an insolvent business is to be liquidated for the benefit of creditors, under the provisions of the bankruptcy act, the procedure is, after the filing of a petition, to appoint a receiver, adjudge the debtor a bankrupt, prepare lists of the creditors and of the debtor's assets, elect a trustee, collect the assets and convert them into cash, establish proof of the debts, declare dividends, and grant a certificate of discharge to the debtor. This law is most valuable. It is responsible for the fact that the former wild scramble of creditors to get ahead of each other in filing attachments on debtors' property no longer takes place. It is responsible also for the further fact that transfers of property intended to defraud creditors or favor certain of them at the expense of others are largely decreased. Nevertheless, the operations of receivers in taking temporary charge of bankrupt estates, and of trustees in collecting and reducing to money the property of bankrupts, are usually performed by young attorneys who are ignorant of business methods, or by business men whose own affairs have not prospered sufficiently to fully occupy them, and hence are frequently marked by waste and delays and the use of value-destroying methods of liquidation. It is a general opinion

among credit officers that bankruptcy proceedings result in destroying one-third of the value of the assets involved, and in paying to creditors thirty-three and one-third cents on the dollar. To avoid as much as possible of these losses and expenses, the members of the National Credit Men's Association have organized, in many cities, credit adjustment bureaus, which undertake to act as trustees representing creditors, and to liquidate property in an expert manner, with the use of the most approved mercantile methods. As a general rule, these bureaus are able to distribute to creditors somewhat more than fifty cents on the dollar.

Fraudulent transfers. — It is well for credit officers, who are called upon from time to time to give counsel in creditors' meetings, and even for travelling salesmen who report the business news of their territories, to possess some knowledge of the identifying marks of fraudulent transfers. The law endeavors to prevent transfers of property of insolvent persons, or of those soon to become insolvent, as a means of defrauding creditors. Transfers which are *prima facie* fraudulent are those without consideration; those with fictitious consideration; those with grossly inadequate consideration, as on unusual credit terms, or on credit to persons not financially responsible; those on promise of support (that is to say, board and lodging); those in payment of a debt and intended as a preference of one creditor over another; those of personal property but with retention of possession; and those made to members of the family or relatives.

Further than this, transfers are revocable if the debtor's purpose can be proved to be fraudulent, and if the buyer or the third party, if a third party is involved, knew of this purpose, or had reasonable cause to know it, that is to say, was chargeable with notice. Transactions where the buyer is chargeable with notice are such as take place under circumstances which would arouse the suspicion of a reasonably careful person. Among such circumstances are, goods offered for inadequate consid-

eration, and stocks in trade offered for bulk sale, especially if the offer is secret or hasty or without the preparation of a proper inventory.

Credit insurance. — Credit insurance is better described by the English title, "Excess bad debt insurance." It is a form of insurance offered to cover unusual losses in collection. In taking out a policy the average bad debt loss of the insured firm is calculated for a period of five years last preceding. This percentage is set down as the own or initial loss and is not covered by the insurance. Losses on accounts above this percentage which result from the insolvency of the debtor are then divided into two classes: first, those involving customers who had, at the time the credit was extended, a capital and first or second-grade credit rating in the books of an agreed mercantile agency and, second, losses on customers not having such ratings. Losses on rated customers are covered in full by the policy, except that the sum insured on any one account is not to exceed a specified sum. Losses on customers without ratings are partly insured, that is to say, the company purchasing the policy becomes co-insurer with the insurance company in respect to such losses. Some of the advantages claimed for this form of indemnity are: (*a*) that a known premium replaces an unknown loss, so that an offsetting charge can be inserted in price; (*b*) that trial balances can show the actual value of accounts receivable; (*c*) that credit accounts are made a more acceptable collateral for bank loans; (*d*) that the maximum amount insurable for any individual account can be used as the credit limit with customers without offending them.

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